THE MODEL ENGINEER

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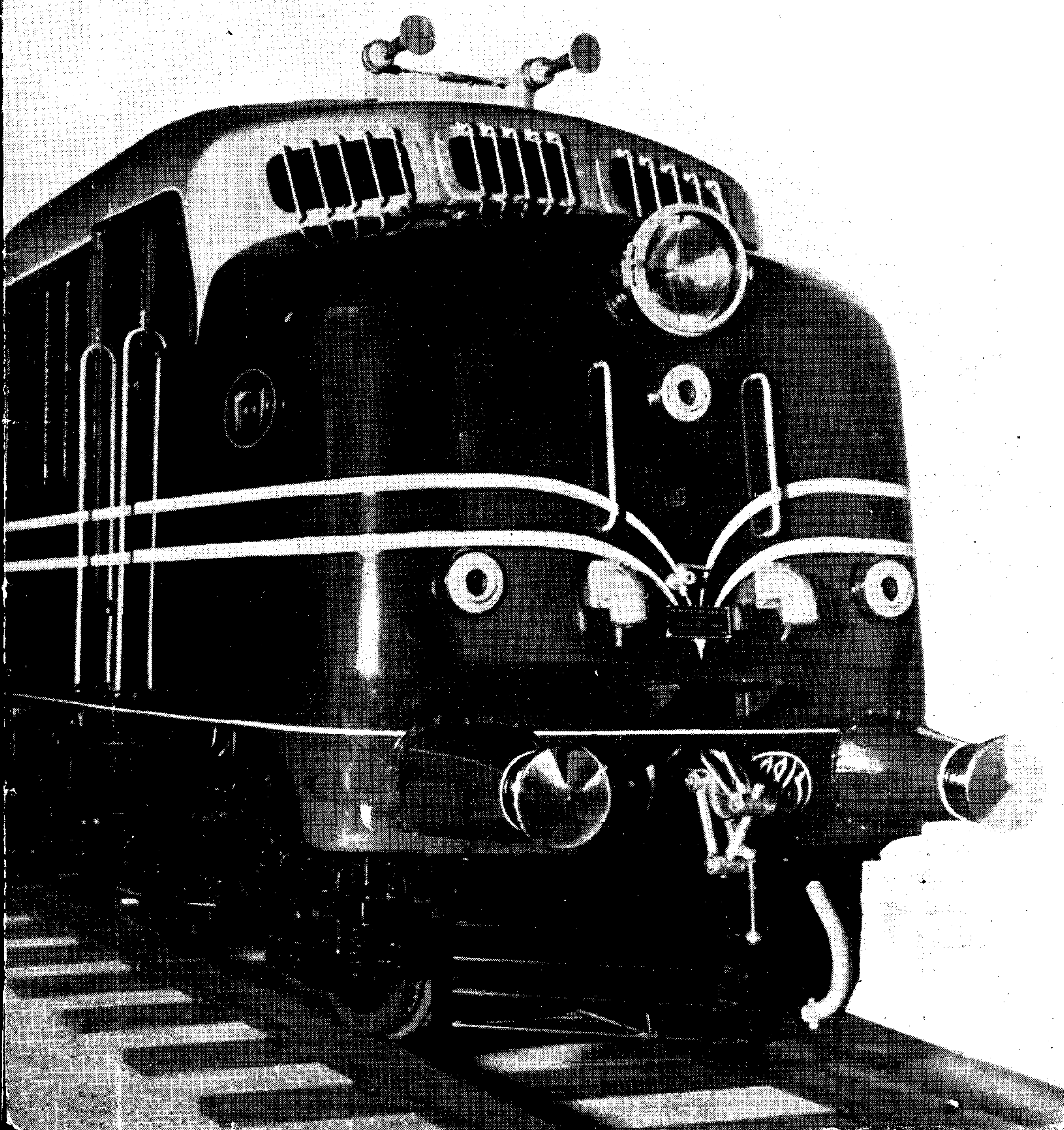


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

3RD MARCH 1949 VOL. 100 NO. 2493

SMOKE RINGS

Model Engineering and Crime

● A LETTER from the Deputy Chairman of the Hampshire Quarter Sessions which appeared in *The Times* on January 24th, has focused public attention upon the alarming growth of juvenile crime, much of which he shows to be attributable to youths conscripted into the Services.

Subsequent correspondence has confirmed the view that for these young servicemen, intimate contact with the hardened young offenders, many with "records," and the boredom of being away from home with too much time on their hands and insufficient money either to buy a ticket home or to pay for amusement, are conditions which result in their being easily lead into crime.

The consensus of opinion is also that some form of hobby suitably introduced would go far to improve the position. It is here, we believe, that model engineering would prove a potent force for good. It has the advantage of being wide in its scope, it costs very little money to organise and pursue, it is satisfying inasmuch as it provides an outlet for creative energy, it is educative and, if adopted by the Authorities, would serve the double purpose of providing training and experience which would be valuable both to the individual and to the nation in the future drive for increased production.

From time to time, news comes to us of the successful efforts of individuals who have introduced model engineering in the Services, one of the more recent being the organising of a model racing car movement in the Army Camp at Catterick. Many are the recorded cases where model engineering or some similar hobby has brought solace to Service personnel condemned to long spells in lonely stations far from the amenities of their normal daily life.

It is regrettable, too, that the persistent shortage of paper restricts the circulation of THE MODEL ENGINEER and other hobby journals, depriving many thousands of the stimuli and ideas needed to develop a hobby which would occupy their leisure.

We hope that serious consideration by responsible authorities will be given to the possibility of developing model engineering and other hobbies in the Services, with a view to mitigating what must be regarded as a serious menace to the future welfare of this nation.

The Chichester Exhibition

● FOR AN example of what enthusiasm, co-operation and the team spirit can achieve, in a society which is only just over twelve months old, we should have to look far to find one better than the first exhibition organised by the Chichester and District Model Engineering Society. The opening ceremony was performed on the afternoon of February 14th, by His Grace the Duke of Richmond and Gordon who, perhaps

is better known to our readers as the Earl of March, of motor racing fame.

The exhibits totalled about 150, no fewer than 80 of which were in the Competition section, and they covered a wide variety.

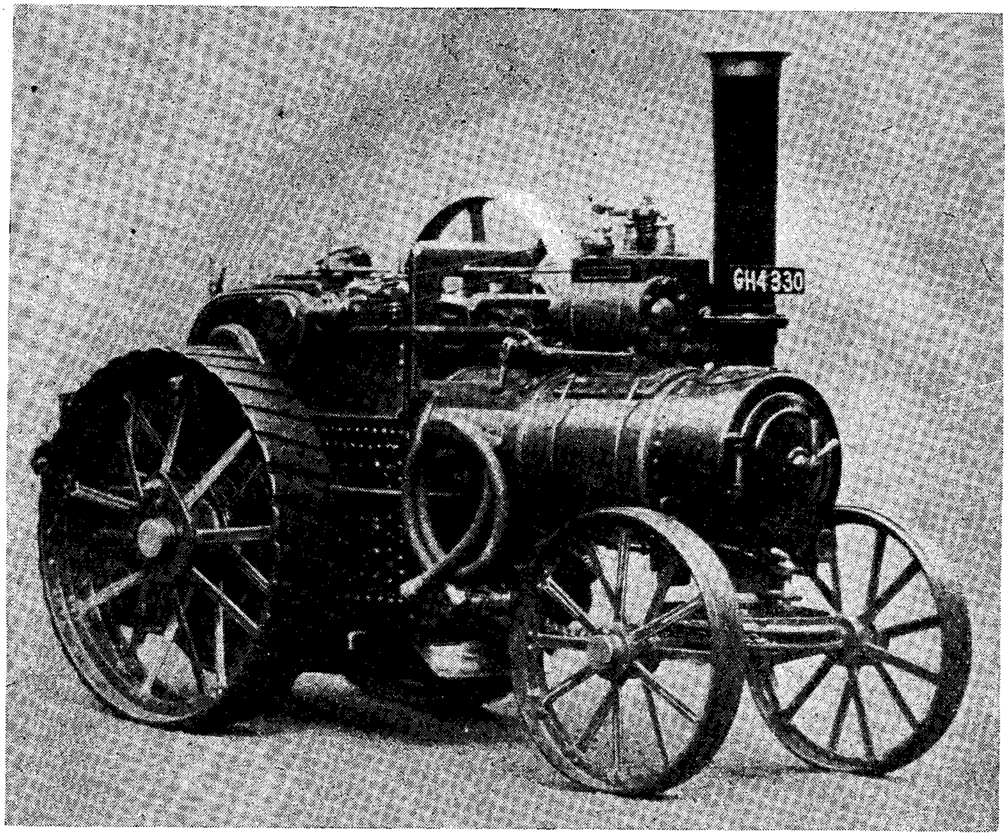
Most of the other clubs in the Southern Federation were represented, and the Royal Air Force, as well as the Army Transportation Centre, Royal Engineers, Longmore, both contributed attractive stands.

We were informed of a project which the Chichester society intends to put in hand almost immediately; through the co-operation of the local corporation, a plot of land has become available, and on it the society will install a sports centre to include workshops, library, meeting-rooms, a multi-gauge track, a car racing track and a trough, or moat, for power boats.

Not so Big as it Looks

● IN "SMOKE RINGS" for August 5th last, J.N.M. referred to the $\frac{9}{16}$-in. scale traction engine built by Mr. G. A Froud, of Weybridge. Here is a hitherto unpublished photograph of this very pleasing little engine, and we think that any readers who did not know the scale to which this engine is built would have difficulty in assessing its size from the photograph. The accuracy of all visible detail is remarkable, but we can vouch for the fact that it all works perfectly; the only snag is that the firebox is so tiny that the lamp will not keep alight! Possibly some form of blowlamp might be more successful, but the first requirement for any burner is an adequate supply of air.

We hope that Mr. Froud will provide us with a complete description of the construction of this remarkable little engine, since much patience and perseverance must have been put into it between the start in 1937 and the completion in 1947.



The Children's Royal Academy

● THE ROYAL DRAWING SOCIETY has informed us that it will be holding an exhibition of children's drawings and paintings at the Guildhall Art Gallery, from Friday, April 1st until Thursday, April 14th next, inclusive. Admission will be free.

Young people throughout the country and in many parts of the Dominions will be looking forward with interest to this event which is popularly known as "The Children's Royal Academy." There is a large number of entries this year, and it includes work from nursery, primary and secondary schools. The exhibits will subsequently be shown in Bristol, Bedford, Bournemouth, Woolwich, Birkenhead and Tottenham.

Remote Control

of a $2\frac{1}{2}$-in. Gauge Steam Locomotive

Being an account of experiments in electricity and steam carried out by Edward and Michael Adams—opening remarks by Edward

THE Falls Grove Railway is a continuous elevated track, more or less circular and 176 ft. in circumference, dodging small apple and pear trees and skirting three boundaries of the garden. This set-up has functioned very well for several years, with occasional truing-up of levels and curves and remaking in part, due to an act of war.

About three years ago, a centre rail was added between the $2\frac{1}{2}$-in. gauge track to suit " O " gauge stock and as a possible pick-up rail for future electrical gadgets. Who first thought of electric control for our steam locomotives it is hard at this time to say, but the idea began to work in our minds, son Michael thinking in terms of electronics and father the mechanics of the problem. The acquisition of various " surplus " motors and other material followed.

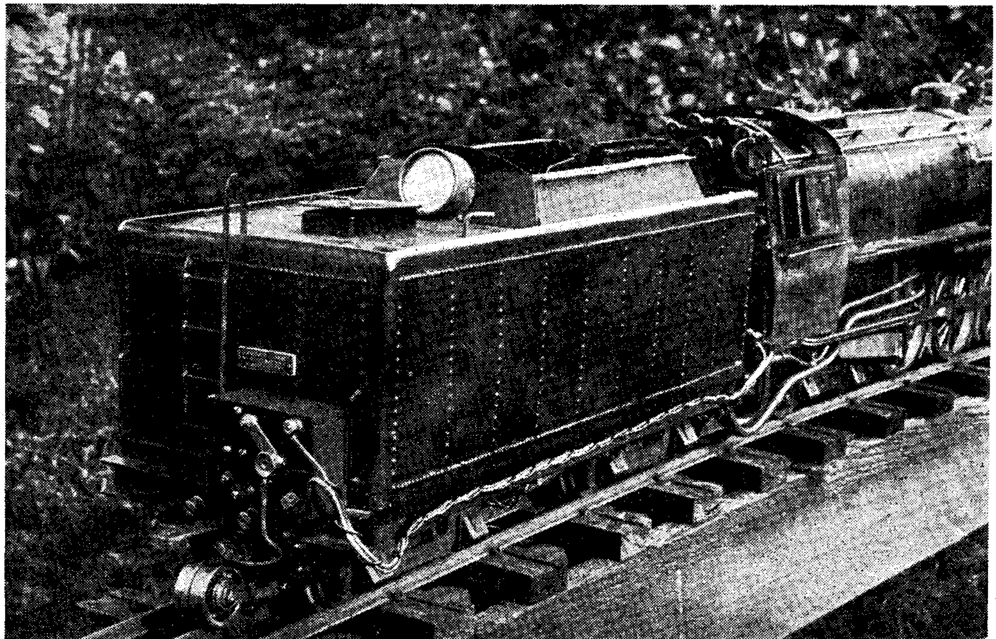
It was agreed that the aim should be to control the running of a locomotive in steam—with or without passengers—from a comfortable seat in the garden or house. Non-wriggling children could be given a safe run, without the risk of excessive speeding and possible derailment, or of burnt fingers and panic in working the regulator.

Further refinements were contemplated, such as tooting the whistle, lighting head and cab lamps, and working a signal, but these have not yet been carried out.

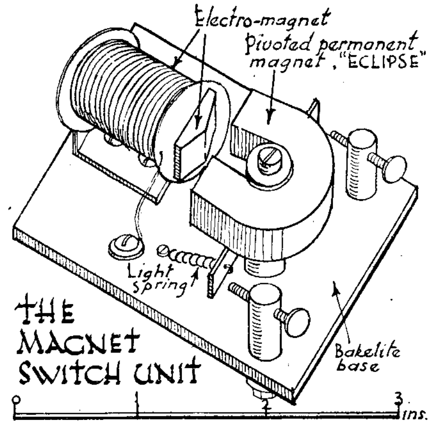
The principal control mechanism is reasonably simple and is, in brief, a small motor standing on the footplate geared to a fine-threaded shaft on which is a nut attached to the throttle or regulator lever—in our case a push-and-pull movement—as simple as that.

The photograph will make this clear, it is hoped. No doubt the idea could be modified for other kinds of regulator handle, or be harnessed to the reversing-screw or " pole." The whole issue can be removed in a few seconds by slacking a screw holding the motor-base to the footplate.

The pick-up or collector consists of two ball-races mounted on a hinged frame ; a light spring keeps them in positive contact with the centre-rail and they revolve with a minimum of friction. The hinged frame is screwed to a plate of insulating material which, again, is screwed to the tender back beam, as seen in the drawing.



The collector and the magnet switch units



Contrary to our expectation, the oil in the ball-races does not offer any appreciable resistance to the current.

Our track, being built up of 10 ft. lengths of brass rail, presents a minimum of joints for bad contacts, and being circular, current can go both ways; but we found it necessary to unscrew some of the holding-down clips—which are our form of chair—and clean them.

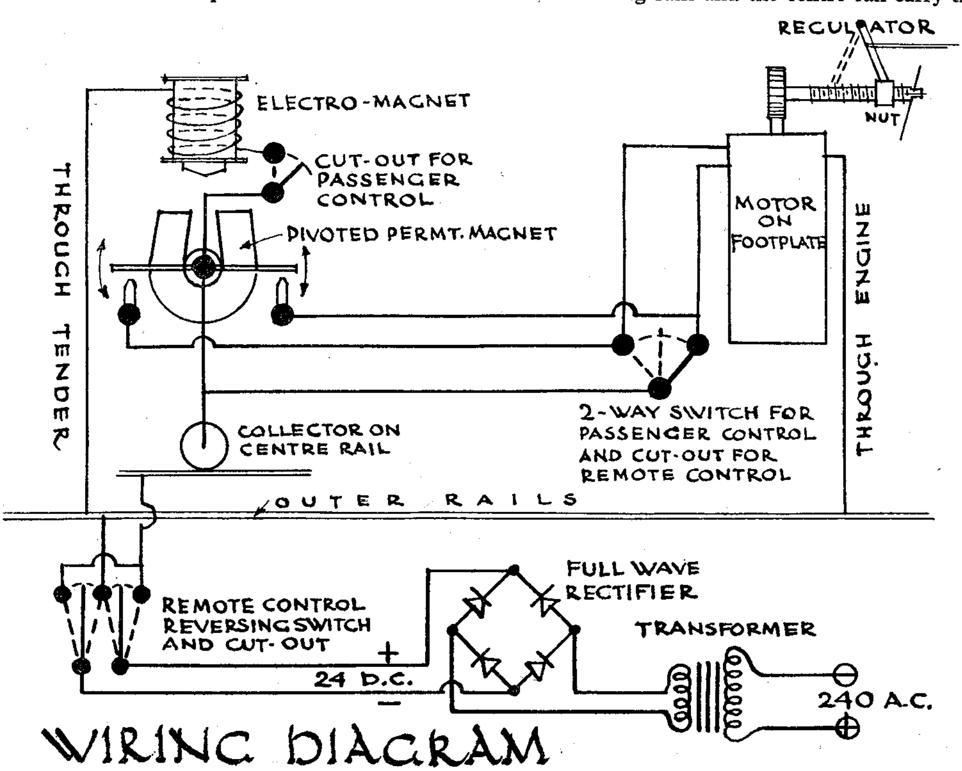
There is a slight drop in voltage on the far side of the track, but not sufficient to affect working. We have in mind the positive connection of all joints in the rails by drilling small holes in the webs of adjacent ends and soldering in copper connecting-wires to make doubly sure of good contacts. It occurs to us that electric control could be used to prevent overrunning at the ends of a non-continuous track, by rail-side switches, setting the footplate motor in action and closing the regulator.

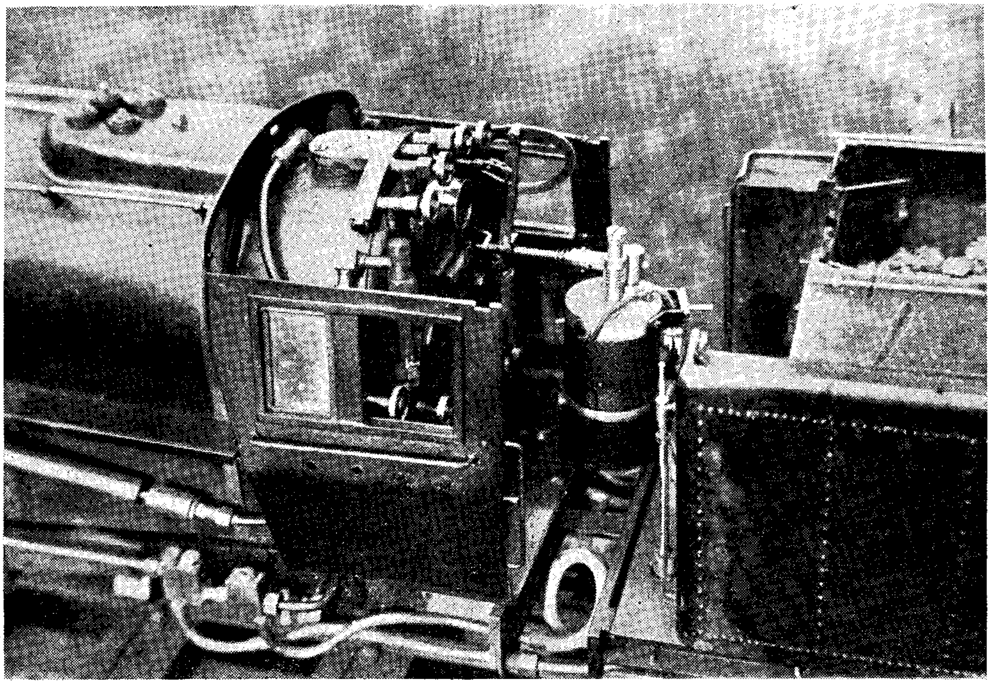
The Electrician

Michael will now take up the story from his, the electrician's, point of view. In order to reduce the risk of shocks and to give sufficient power for the work required, 24 V d.c. was decided on. A transformer is used to step-down the mains voltage of 240 to 24 V, which is then rectified by a full-wave rectifier. The current is then carried to a position near the track by twin bell-wire. Between this position and the rails, however, a reversing-switch is introduced. This is done by two sockets under a window-sill nearby, one socket connects to the supply side, the other to the rails by twin wire taken underground in conduit.

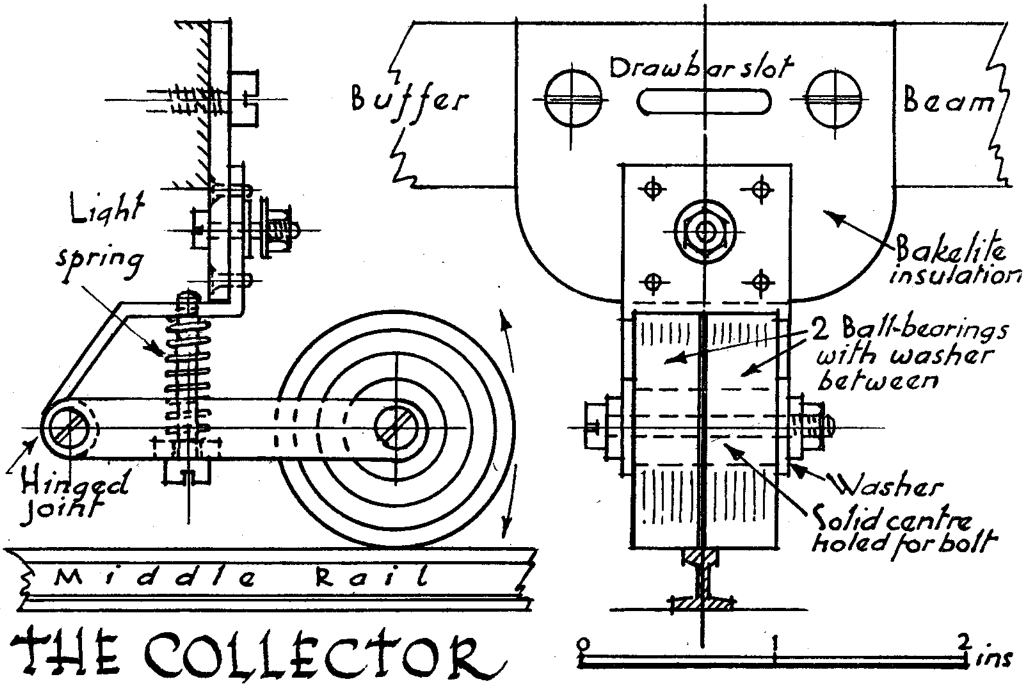
Between the two sockets, and connected to them by push-in plugs and a few yards of twin wire, comes the reversing-switch, artfully hidden in a small box, only the operating lever projecting. The considerable length of wire enables the control operation to be effected from positions in the house or garden. The box is large enough to accommodate the various parts when dismantled from the locomotive and tender.

The running-rails and the centre-rail carry the





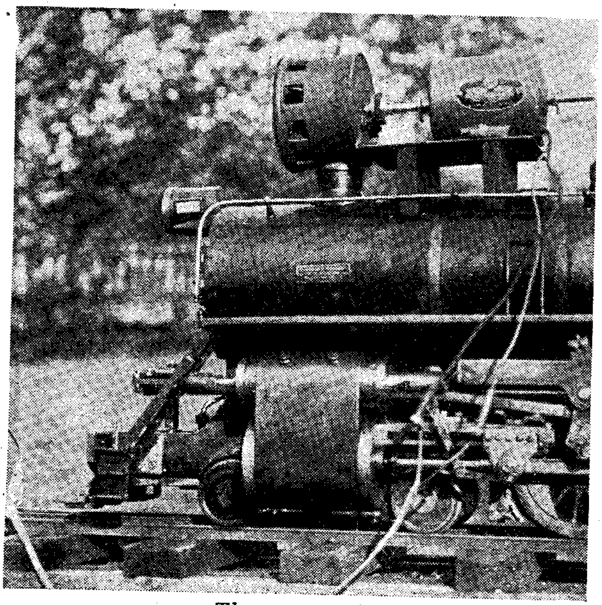
The footplate motor



THE COLLECTOR

current around the track, the locomotive and tender acting as return conductors. Current is picked up from the centre-rail (or vice versa) by an insulated collector attached to the tender and carried to the footplate motor by insulated wire.

The footplate motor, also "surplus," is of the wound laminated field type. This means that it cannot be reversed simply by reversing the current, but requires two circuits. Therefore, we had to devise some form of switch where current is reversed in the field only; the drawings will show how it was accomplished by what we term the magnet switch unit, which has the effect of closing alternative circuits to the motor, according to the direction of the current supplied to the rails, and thus reversing it.


The steam raiser

In brief, the working of the magnet reversing-switch is as follows: When current flows one way, it induces a north pole in the electro-magnet, which attracts the south and repels the north poles of the permanent magnet, partly rotating it in one direction and closing a circuit to the motor.

Current flowing in the opposite direction turns the magnet the other way and closes the second circuit, breaking the first one. A light spring brings the magnet to a neutral position when no current is flowing.

As the magnet switch is wired in parallel with the motor, it must have a fairly high resistance, in order not to rob the motor of too much current for effective working. The wiring diagram also shows how the motor can be operated by a passenger, by means of a two-way and cut-out switch on the footplate. This last was a later idea and owed its inception to faulty working of the magnet switch; while two heads were busy trying to put it right, the boiler ran dry, to our shame and humiliation!

Almost Uncanny

We are very pleased with the result of our joint effort and heartily commend remote control to brother locomotive enthusiasts. To see the locomotive start, speed up, slow down and stop without apparent human agency is almost uncanny and adds immensely to realism.

We expect to be amused at the behaviour of a newcomer to the line. The procedure will be to set him going merrily around the track behind a locomotive in steam. When he is well under way, we shall steal off with the control switch to a point of vantage behind the lounge window curtains—where the control will be not only remote but invisible— there to slow down and accelerate him to his complete mystification.

At the first stop, he will probably hop off to see what's wrong, the locomotive will start again unaided, he will hastily remount, only to stop again and so on until he notices the motor at work and begins to track the wiring, whereupon we shall emerge chuckling from our hiding-place, to be chased around the circle by an irate passenger, brandishing the coal hammer—or so we expect!

Steam Raiser

Surely the Bomb Sight Computer Unit is the richest mine yet available for model engineers. From our purchase came much valuable material, including two small motors. Having electrified the track, what could be more desirable than to use it for supplying energy for steam-raising by one of the said motors coupled to a fan? Which we did, after some experimenting with size and type of fan.

The motor is wired to use 1.5 amps. at 27 volts and 5,400 r.p.m. A propelling fan was first made and tried; but it lacked pull, perhaps owing to the position of inlet which stopped short just inside the fan chamber. After extending the inlet nearly to the centre of the chamber and substituting a six-bladed centrifugal fan $2\frac{3}{4}$ in. diameter, the gadget functioned splendidly.

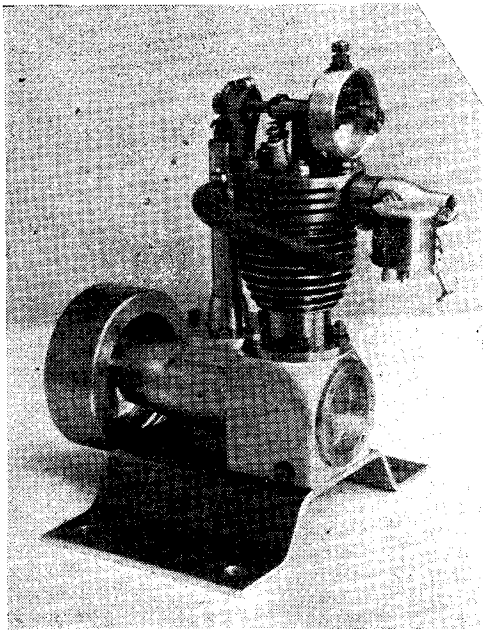
The coupling between fan and motor is by means of a leather disc having four equally-spaced holes punched through it. Two opposite holes engage with spigots on the motor spindle and the other two with those on the fan spindle. This gives sweet running, as any inaccuracy in alignment of the spindles becomes less critical.

Two wood chocks or saddles shaped to the boiler radius carry the motor and prevent the transmission of heat from the boiler, being of soft timber they do not damage the paintwork. There is practically no noise or vibration and steam is raised in a few minutes.

[The above article reveals an interesting application of electro-mechanical control for miniature locomotives; the method is not exactly similar to any that we have previously seen of this kind, and it suggests ideas for further developments.—Ed., "M.E."]

A Built-up 10 c.c. Petrol Engine

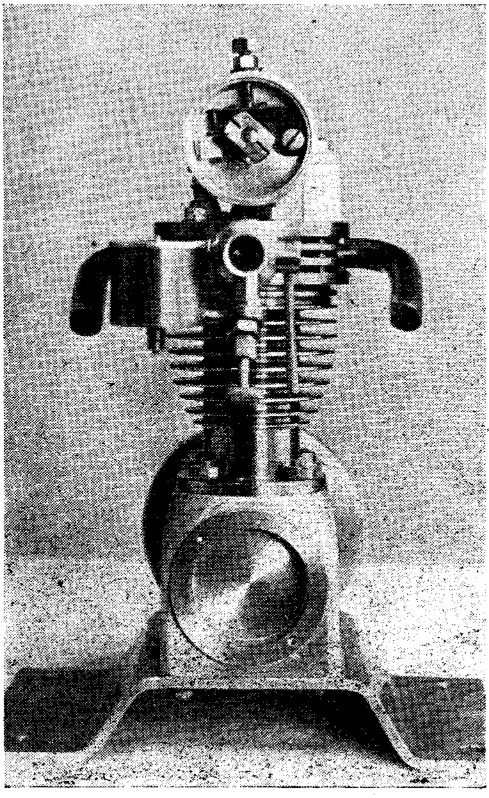
by D. H. Dray



WITH the aid of a $3\frac{1}{2}$-in. Myford lathe, I recently completed the 10 c.c. $\frac{7}{8}$ in. bore by 1 in. stroke engine illustrated in the photographs.

The cylinder was turned from $2\frac{1}{4}$-in. high-tensile steel bar, and the bore machined with a floating cutter. It was then lapped until a mirror finish was obtained. The cylinder-head was also turned from steel, with twin exhaust ports. A cast-iron piston was turned and fitted with two rings, a difficult job which nevertheless gave the author a great deal of satisfaction. The connecting-rod is bushed at both ends.

Turned from high-tensile steel, the crankshaft runs in two ball-races, and is fitted with a bevel gear of 1 : 1 ratio, which drives the vertical shaft of the valve mechanism. This shaft is fitted with a ball-race at the bottom end and a plain bearing at the top. The final drive to the camshaft, which is of $\frac{3}{16}$-in. silver-steel running in two $\frac{3}{16}$-in. $\times$ $\frac{1}{2}$-in. ball-races, is through 2 : 1 bevels. Cams were machined from high tensile steel, and when they had been fitted and the engine tried for performance, were finally pinned to the shaft.



The valves were machined from old car valves, and fitted with tapered split collets, the stems running in brass guides. To stop side loading of the valves, two leaf springs were mounted on the block. These are preloaded, and act as cam followers. Thrust is taken by small hardened thimbles fitted to the valves.

The crankcase is made in two halves, and these are screwed together with a fine thread, the joint occurring at the large end of the tapered bearing housing.

The carburettor is on the barrel throttle principle, fitted with adjustable needle-valve, cork float and brass float chamber.

There is no provision for forced lubrication, the engine being run at present with a wet sump, with the addition of a " petroil " mixture for top lubrication.

It is not proposed to deal at length with the contact-breaker mechanism, as this can be seen quite plainly on one of the photographs. The outer casing is so designed that it can be rotated while the engine is running, thus providing adjustment for advance and retard.

The present flywheel was turned from brass, and although suitable for running as a stationary unit, is too heavy for its intended purpose, i.e. marine installation ; it is, therefore, my intention to fit a lighter flywheel at a later date.

Much to my surprise, the engine presented no difficulty in starting, and after about three hours of experimental tuning, I was able to obtain the desired speed control and power output.

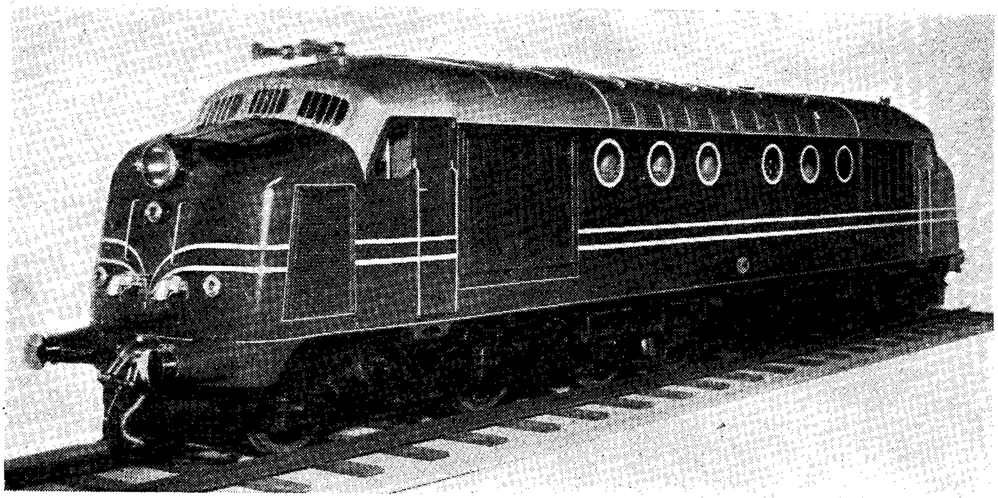


Photo by] [Leslie Overend

The 1-in. scale model diesel-electric locomotive

A NOVEL SHOW-CASE MODEL

SHOW-CASE models of ocean liners, power-houses, aeroplanes and the like are familiar enough; and often they are superb specimens of their kind, especially when they have been built by any of the well-known model manufacturers who specialise in that class of work. But a rather striking fact is that, presumably because such models are frequently made of wood, the steam locomotive has seldom figured among them; while models of ships and aeroplanes could probably be numbered in their thousands, we can recall less than a dozen locomotives.

Whatever may be the explanation of this, it is, nevertheless, a singular circumstance; for, so many locomotive enthusiasts seem to visualise "pictorial" models of their favourite types, but seem to hesitate to produce them using wood, pieces of wire, tube and other simple odds and ends as material.

However, we have been favoured by Mr.

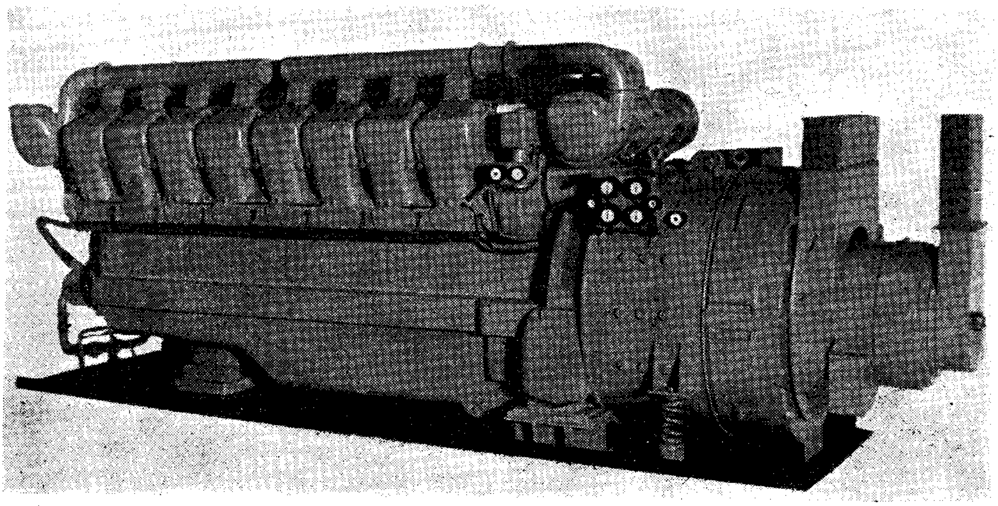
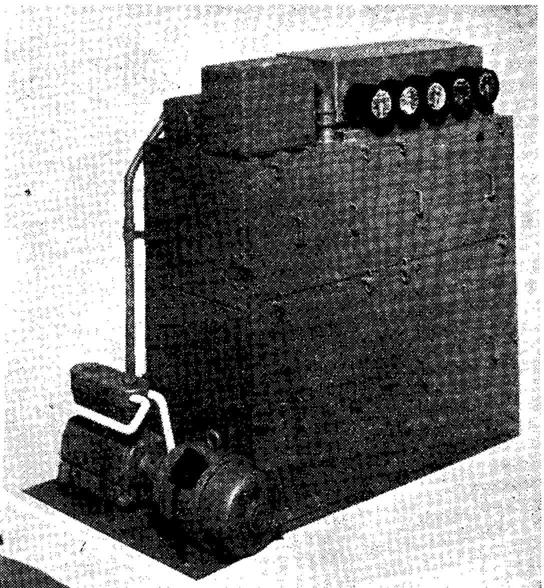


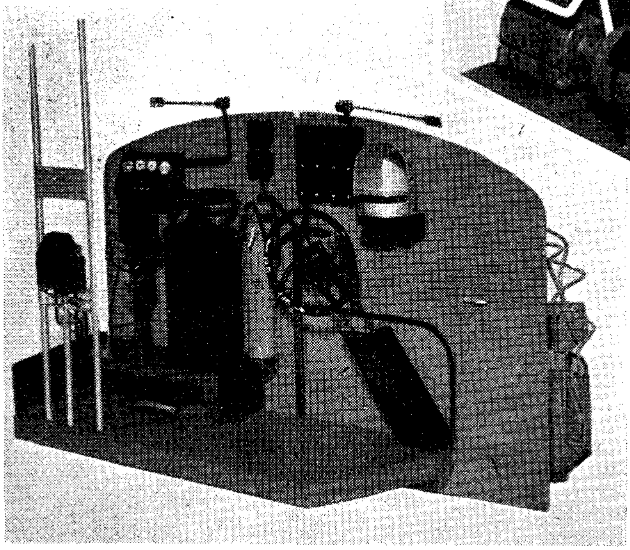
Photo by] [Leslie Overend

The engine, dynamo and exciter units of the diesel-electric locomotive

H. Leslie Overend with the photographs reproduced on this and the opposite page, as well as on the cover. They illustrate a very fine show-case model which has recently been completed by Edward Exley & Company to the order of the English Electric Co. Ltd. The model represents, to the scale of 1 in. to 1 ft., a diesel-electric locomotive which has lately been delivered to the Egyptian State Railways. All internal and external detail has been incorporated in the model, though, of coure, it does not work. The 16-cylinder, V-type diesel engine and generator unit, together with all relevant piping and wiring, are excellently reproduced, exactly to scale. The various ammeters, voltmeters, and



Above—One of the smaller auxiliary units



Left—Photo showing the cab fittings

[*Photos by Leslie Overend*]

other measuring instruments should be noted.

One of the auxiliary compressor units is also illustrated and will be seen to be a very faithful reproduction of its prototype, so far as external details are concerned. The controls in the driver's cab are all accurately represented; in fact, there is probably nothing on the full-size engine that cannot be found in miniature on the model.

The external finish is green with yellow lining, though the underframes and running-gear are black.

The model has been sent out to Egypt, where it will be on view at the forthcoming Centenary Exhibition of the Egyptian State Railways; afterwards it will be placed in the Cairo Museum, which already houses several exhibits relating to the history of the Egyptian railways.

It was anticipated that the model would require two years for its construction, but production was speeded up so much that completion was possible within twelve months of the order being placed. Even so, a lot of excellent work has obviously gone into the model; many of the parts, including the massive "cylinder casting," are made of wood carefully carved to accurate shape and size; the results can be clearly seen in the photographs.

News from Stroud

WE are glad to learn that the Stroud and District Model Engineering and Handicrafts Club came into existence at a meeting held recently. Mr. J. V. Reynolds states that a membership of about fifty is expected, and this includes Mr. Spinks, founder of the Harrow Society of Model Engineers. The hon. secretary is Mr. Webb, 2, Bath Road, Stroud, Glos., who would be pleased to supply any interested enquirer with all information as to joining the club.

*The "Eureka" Electric Clock

by "Artificer"

HAVING completed the building-up of the balance wheel, the electrical components incorporated in this unit may be considered. The contact pin assembly, shown in detail in Fig. 5, comprises a fibre or bakelite bush turned to fit the split clamp in the wheel cheek, and drilled $\frac{1}{16}$ in. through the centre to take the half-round pieces of metal and insulating material, which should fit fairly tightly, but not so as to risk bursting the bush. A piece of 16-gauge silver wire is recommended for the contact pin, but if not available, nickel-silver (german silver) will give fairly good results. It should be carefully filed to a half-round section, using a micrometer to gauge when exactly half the diameter has been filed away.

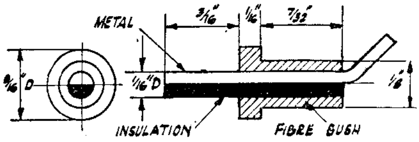


Fig. 5. Details of contact-pin assembly

A piece of glass or quartz rod $\frac{1}{16}$ in. diameter is the most suitable material for the insulating side of the pin; this may be obtained from a shop dealing in laboratory glassware, and after the required length is cut off by nicking with a file, it should be embedded in a pitch block and ground down flat on one side on a metal or glass lap charged with carborundum paste. As it may be difficult to gauge exactly how much material has been removed in this case, it may be advisable to do this before making the metal part, and adjust the thickness of the latter to suit. If vitreous material is considered too difficult to work, the next best substitute is a piece of hard plastic material, such as a knitting needle, which is first turned down to the required diameter and then filed half-round. Adhesion between the projecting ends of the metal and insulation can be obtained by the use of a cement such as Durofix, or by melting in a flake of shellac. When fitted to the bush, and the latter clamped in place in the cheek of the wheel, the pin should be quite secure. The inner end of the metal portion should be bent outwards as shown to form a convenient solder tag for connecting the outer end of the magnet coil.

Winding the Coil

A bobbin for the coil should be prepared, preferably by turning from the solid in ebonite, fibre or bakelite, though it may be fabricated from tube, with end washers cemented on, if this is more convenient. The thickness of the tube and end cheeks should not be more than $\frac{1}{16}$ in., and the bobbin should be a free sliding fit on the core, its overall length being adjusted to fit neatly inside the rim of the balance wheel.

The magnet coil of the clock examined had a resistance of just over 20 ohms, which represents about four layers of No 24 gauge wire. In the writer's opinion, a coil of higher resistance would be an advantage, as the power obtained from the magnet on an input of $1\frac{1}{2}$ volts appears to be greater than is necessary to maintain the swing of the wheel, and is liable to affect the accuracy of timekeeping. The higher resistance would also improve economy of current consumption, with longer battery life and less variation of voltage. It will be noted that most battery-driven clocks in which the impulses are frequent, work best with magnets of high resistance. There is plenty of space in the balance wheel for considerably more turns of the same gauge wire, or, alternatively, a smaller gauge of wire may be used to increase the resistance.

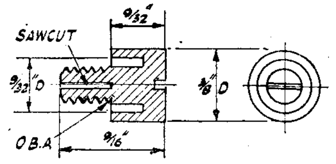


Fig. 6. Poise screws (12 off)

The wire may be either enamel, cotton or silk covered, and the process of winding it is quite simple; it may be carried out either in the lathe, drilling machine, or on a hand-driven spindle. There are not enough turns on the coil to make winding tedious. Care should be taken in laying the turns so as to ensure neat and even winding, which, although not important from the electrical aspect, affects the balance of the wheel, as well as its appearance.

The first layer of a coil is always easy enough to lay evenly, but difficulty is often encountered with subsequent layers owing to the slipping of end turns. If this trouble arises, a layer of stiff paper or Empire cloth may be interposed between the layers of wire; it should be cut to fit the length of the bobbin closely and with a moderate overlap, so that it can be cemented down with Durofix or shellac varnish. When the coil is completed, it should be well varnished externally, the object being not so much to improve insulation, which is not at all highly stressed, in view of the low operating voltage, as to fix the turns mechanically and prevent them moving afterwards. The end turn may be tied in place with silk or cotton thread.

*Continued from page 208, "M.E.," February 17, 1949.

To assemble the wound bobbin in place, it is, of course, necessary to remove one side of the balance wheel and slide out the core piece ; if the pivot has been made in one piece to serve as a mandrel when building up the wheel, its centre must, of course, be cut out to allow the bobbin to be fitted. If there is any end play of the latter inside the rim of the wheel, paper washers should be cemented to the side cheeks to take this up ; no movement of the bobbin is permissible when the wheel is assembled. The inner end of the coil winding is connected, by soldering or other convenient method, to the wheel structure, and the outer end soldered to the bent inner end of the contact pin. The arrangement of the core piece and side plates, with a single iron clamp block at one end, and the wound bobbin on the core, constitutes a three-limbed or "trident" form of electro-magnet. Assuming the tip of the core, at the end remote from the iron clamp piece, to be a N pole, the adjacent ends of the side plates will both be S poles. This constitutes a highly efficient form of magnet, and when working in close proximity to the armature plate, as it normally should, the system is completely "ironclad," so that there is practically no stray field to reduce efficiency or cause trouble by magnetisation of the hair-spring. A test of the magnet, by connecting a single dry cell between the contact pin and the balance-wheel frame, should show a powerful attractive force when a piece of iron is held near the open poles, with a current flow of about 75 milliamps at this voltage input.

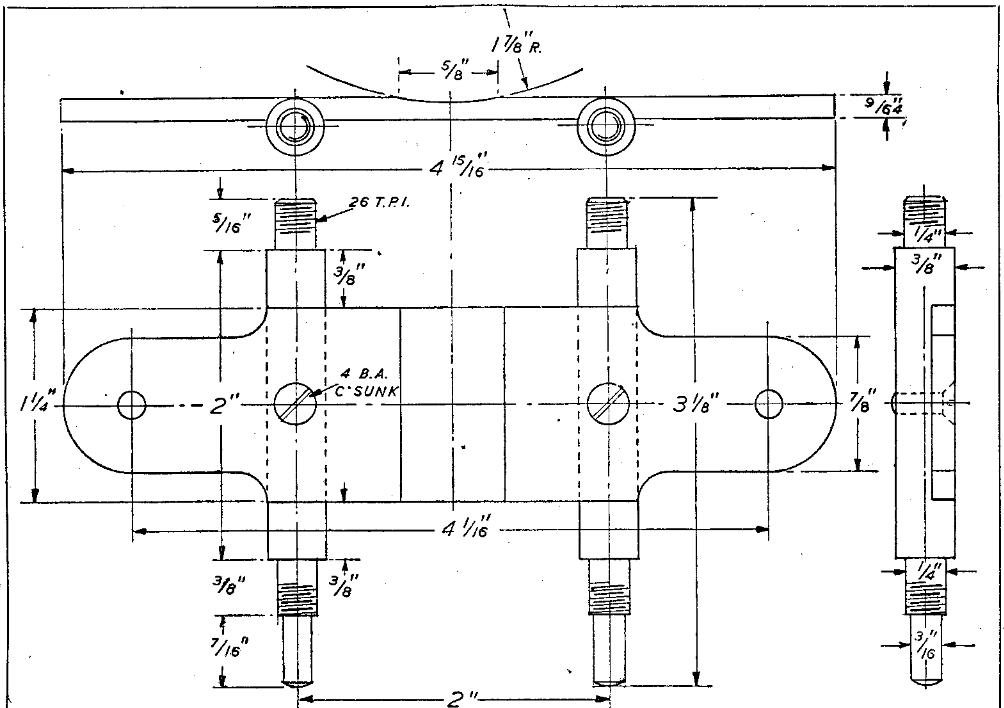


Fig. 7. Armature plate

Poise Screws

When the complete balance wheel is assembled and spun on its pivots, it should run truly and be fairly well balanced. Any error in this respect should be corrected before going further ; assuming this is in order, however, the rim may now be split in two places, as shown in Fig. 4. The width of the gap is not critical, but the same amount of metal should be removed in each case, to maintain proper balance.

The fitting of poise screws is not absolutely essential, though it is usual in a compensated balance wheel. Both the balancing and the natural period of the wheel are influenced by the poise screws ; they may be used to affect the rating or regulation of the clock, but their most useful function in the case of watches is the correction of position errors—that is to say, variation of timekeeping accuracy according to the position and angle of the watch frame. In the case of the "Eureka" clock, in which the position of the balance wheel axis is not likely to vary, this condition does not arise ; but the weight and location of the poise screws also affects the period in relation to the arc of balance wheel swing. Adjustment in this respect may be very useful, though not easy to apply in practice unless one is an experienced horologist.

It will be seen from the photographs that the poise screws are not screwed fully home against the rim of the wheel, and in view of the fact that the shanks of the screws are split to provide a friction grip in the tapped holes, it can be assumed that they were definitely intended to be

adjusted in this way. This is, however, contrary to the best watch practice, where the screws are fully tightened, and adjustment of balance or moment made by filing the screw heads, or, conversely, fitting ballast washers under them.

The detail drawing of the poise screws, Fig. 6, shows that an annular groove is machined in the underside of the head, which may possibly have been intended for ballasting with lead or similar material. As this groove will require a special tool to machine, it may be omitted and the screw head shortened to compensate for the increased weight. All the poise screws, twelve in number, should be of equal weight, and should be adjusted in the rim so that the balance wheel will rest in any position when poised on knife-edges.

The hair-spring may be made from a mainspring of a small watch. It consists of approximately 12¼ turns, the material being spring steel 0.096 in. wide by 0.015 in. thick. The centre of the spring is attached to a brass collet by swaging into a tangential sawcut, and the collet is mounted on the arbor with a 14-B.A. grub screw, which is convenient for setting the balance correctly in beat. If desired, however, the usual friction-tight split collet may be fitted.

Armature Plate

This is made from annealed iron or mild steel, and forms not only the armature but also the foundation plate of the clock movement. As shown in Fig. 7, it is 1½ in. wide in the central portion, and 9/64 in. thick, with pillar studs made either of brass or steel attached underneath. The latter have flats filed or milled to a depth practically equal to the thickness of the plate, and fitting tightly over the edges of it, so that one screw in each stud will hold it securely. At the ends of the plate, holes are drilled for the screws or studs which secure the vertical pillars by which the entire movement is mounted on its plinth or bedplate.

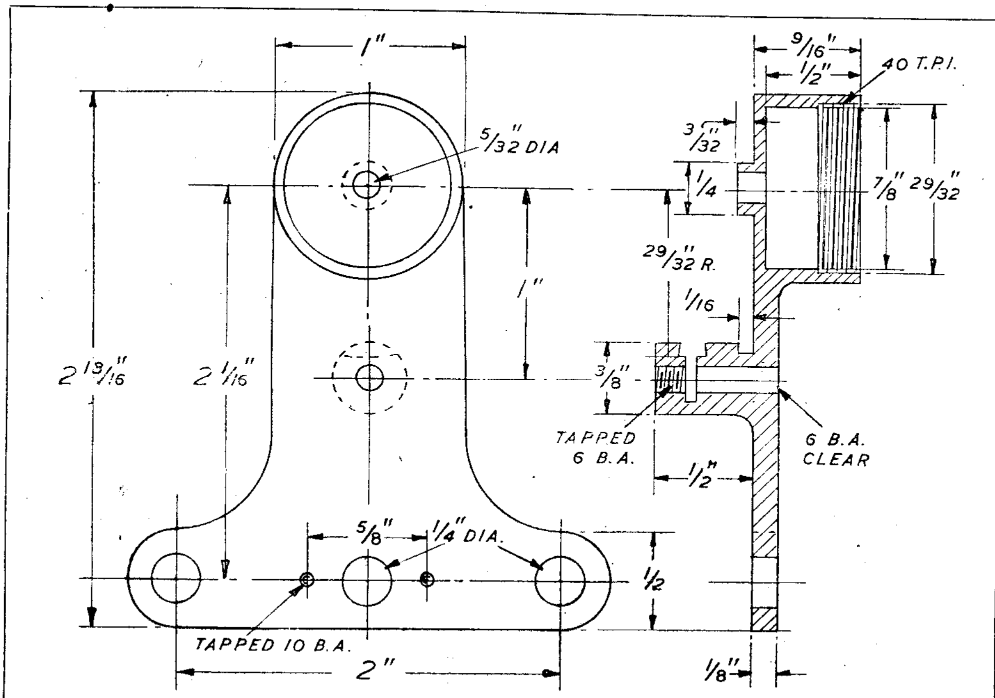


Fig. 8. Rear motion plate

It will be seen that the centre portion of the plate is machined to an arc corresponding to the radius of the balance wheel pole tips, plus clearance. This can be machined with a cutter held in a boring bar between lathe centres, the plate being clamped vertically to an angle-plate mounted on the lathe cross-slide, with its centre level with the lathe axis. In a small lathe, it will be found necessary to overhang the work to one side of the cross-slide to obtain necessary clearance.

The amount of metal to be removed here is quite small, and it is doubtful whether machining such a short arc has much effect on the magnetic efficiency as compared with a plain flat plate. In the event of difficulty in machining this surface, it is fairly certain that the clock will work satisfactorily with the plate left flat, so long as the working clearance of the pole tips of the balance wheel is suitably adjusted.

Rear Motion Plate

Both the motion plates of the " Eureka " clock are made from brass castings, but they may be fabricated by silver-soldering the bosses on to

flat brass plates. The housings for the balance-wheel pivot bearings are integral with the plates, and the rear motion plate, shown in Fig. 8, also incorporates a pillar which serves to anchor the outer end of the hair spring, and also locates the regulator quadrant. A spigot is provided on the inner centre of the bearing housing for the quadrant to pivot on.

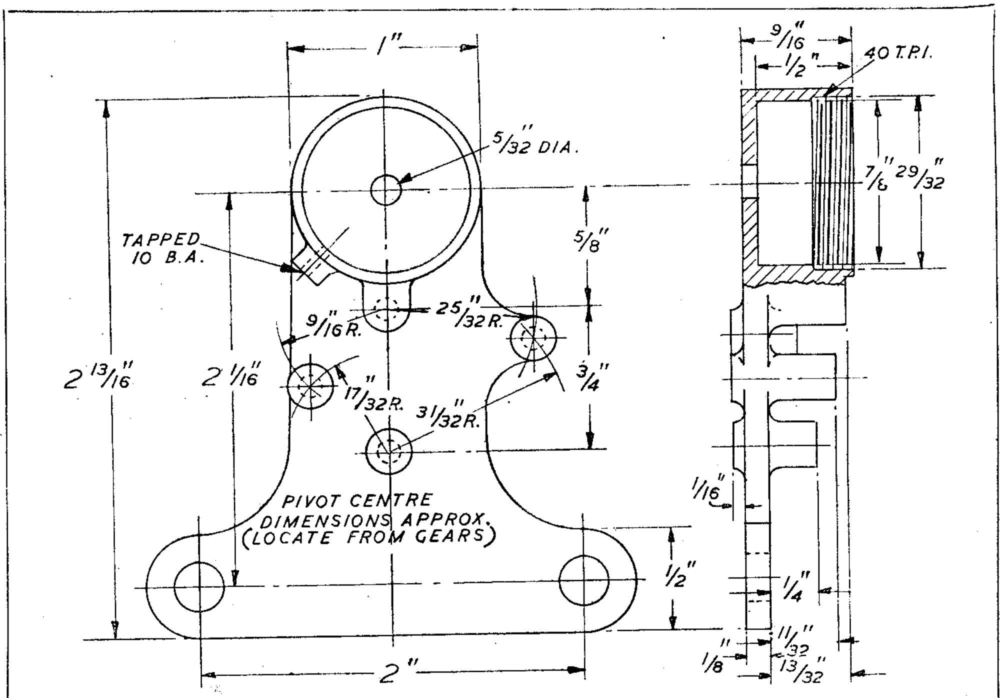


Fig. 9. Front motion plate

In machining the motion plates, the most important operation is the boring and screwing of the bearing housings, which may be carried out by clamping the plates to the lathe faceplate. It is advisable to take a skim over the face of the lower extremity of the plate, where the holes are drilled to fit the pillar studs of the armature plate, and afterwards reverse the plate, mounting the housing on a plug mandrel, to face the other and more important side of this surface. The object of this is to make certain that the two housings will be axially in line when the plates are assembled in position ; but location in this respect is by no means as positive as it might be, and this feature constitutes one of the structural weaknesses of the clock. It is desirable to provide some means of clamping the plates together, with the housings correctly aligned, for drilling the holes for the pivot studs. The spigot on the rear housing is an obstacle to doing this, and, if desired, it may be made separately and screwed or sweated in afterwards, instead of being integral with the motion plate.

The pillar near the centre of the rear motion plate, already referred to, is drilled centrally to take a 6-B.A. screw, and cut about three-quarters of the way across, preferably with a circular slitting saw. The upper part of this slot is then stepped out wide enough to grip the edges of the hairspring ; a slight undercut here will be desirable. By tapping the rear portion of the hole, and opening the rest out to clearance size, the pillar will act as a clamp to secure the spring when the screw is tightened.

Front Motion Plate

The bosses for the gear-wheel pivots are shown in their approximately correct positions (Fig. 9), and whether the plates are cast or built up, this will be sufficiently exact for practical purposes, so long as the actual pivot holes are located by the usual horological methods when setting up the train. But it is extremely likely that some variation of the size or arrangement of the gearing may have to be made for the purpose of utilising existing or readily available gears ; in which case the pivot bosses may be set out accordingly.

It will be seen that a boss is cast or otherwise permanently attached at an angle under the bearing housing for the anchorage of the spring which acts as the backstop of the ratchet wheel, and the position of this also may have to be modified to suit the gearing. In all other respects, the machining of this motion plate is the same as the rear one.

(To be continued)

In Quest of Speed

by S. H. Clifford

Being an account of 25 years' work on Steam and Petrol Boats

MANY readers will probably remember my early efforts way back in 1923 when my boats *Chatterbox I*, *II* and *III* were gradually raising the official speed record. The final figure put up by *Chatterbox III* being 43.3 m.p.h. This record stood for approximately 10 years until the Innocent Bros. raised it to 47 m.p.h. with their boat *Betty*, a 30-c.c. petrol boat.

When this record was announced, I realised I had rested on my laurels long enough and after a lot of consideration as to whether the next boat should be flash steam or petrol, I finally decided that although I knew very little about the latter I would "have a go."

Quite a time was spent in studying motor-cycle handbooks and catalogues and going through back numbers of THE MODEL ENGINEER until I had a fair idea of what a modern (at that time) high-speed engine should look like.

It was finally decided that a 25-c.c. o.h.v. Bond's engine, slightly modified would be most suitable for what I had in mind.

So accordingly a set of castings, minus the head, was obtained. These were machined up and with a c.i. head of my own design, incorporating inclined valves, was installed in one of my old flash-steam hulls.

Then the trouble started. Push-rods jumped out and were lost in the pond, camshafts bent, cams wore out, valves got bent, float chambers broke off, plugs either oiled up or burnt out, etc., etc. This went on for 18 months, but during that time I was learning things about petrol engines, and that was invaluable in building subsequent engines. However, at the end of this time a speed of 39½ m.p.h. was clocked, which, although not nearly good enough, was very encouraging.

It was the best speed this boat ever did, as Jerry came over one night and flattened my workshop, and when this boat (*Crackers*) was eventually found, it had to be written off as a total loss.

A new workshop was eventually built and work commenced on another engine.

It was decided this time to make a 30-c.c. job and incorporate all the up-to-date features, including aluminium cylinder-head with p.b. valve seats, valves at 65 deg., large inlet and exhaust passages, aluminium cylinder with shrunk-in c.i. liner, KE805 connecting-rod with needle bearing big-end, ball-bearing main bearings and camshaft, dry sump lubrication, petrol pump and a magneto.

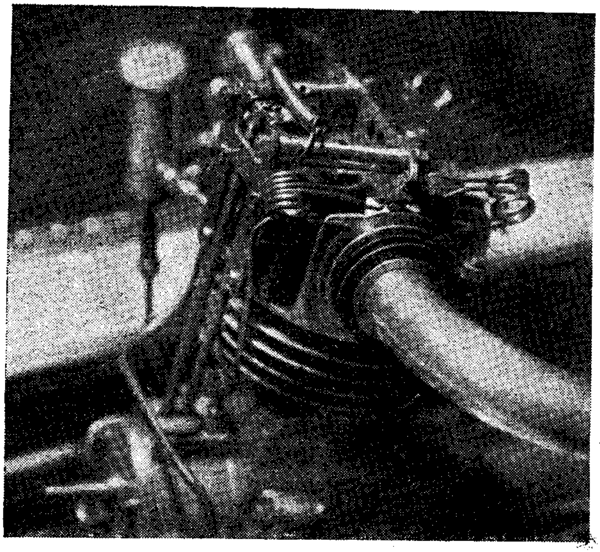


Fig. 1. O.H.V. rocker arrangement

After long discussions with various members of the V.M.S.C., including Mr. E. Clarke and Mr. Westbury, the engine began to take shape. Details of these features and their construction will probably be of interest, so starting from the top of the engine, the valve-rockers were turned from a solid chunk of case-hardened nickel-chrome bushed with p.b., a space being left between the bushes to retain a small quantity of lubricating oil. A shouldered c.h. bolt passed right through and was locked up tight to the rocker bracket by nuts each end, as shown in Fig. 1. Also shown is the valve-springs which exert a pressure of 18 lb. on each valve.

The push-rods were made from steel tube and fitted with mild-steel case-hardened ends, the top ends being hollow cups and the bottom, ball ends. These end-pieces were shouldered and had a short extension that was a tight fit inside the tube.

The method of valve clearance adjustment was by ball-ended bolts and lock-nuts. These bolts were made from "Unbrako" keys, softened, turned to shape, case-hardened and then tempered to a light straw. These bolts, of course, were screwed into the inside arm of each rocker.

I can thoroughly recommend the use of these keys for any highly stressed part. Even in their soft state they are exceedingly tough, and were used in this state for the camshaft.

The frame carrying the valve-rockers was secured to the cylinder-head by four 2-B.A. nuts (which also serve to hold the cylinder-head down) and two 2-B.A. screws, as shown in Figs. 1 and 2.

Valves were $\frac{5}{8}$ in. diameter with 5/32-in. stems, protrude about 1 in. beyond the end of the spindle and had strips of emery-cloth of various grades wound round it and wired. It will be seen that the rubber tube being flexible, it was possible to push it into the port passages and follow the contour of same.

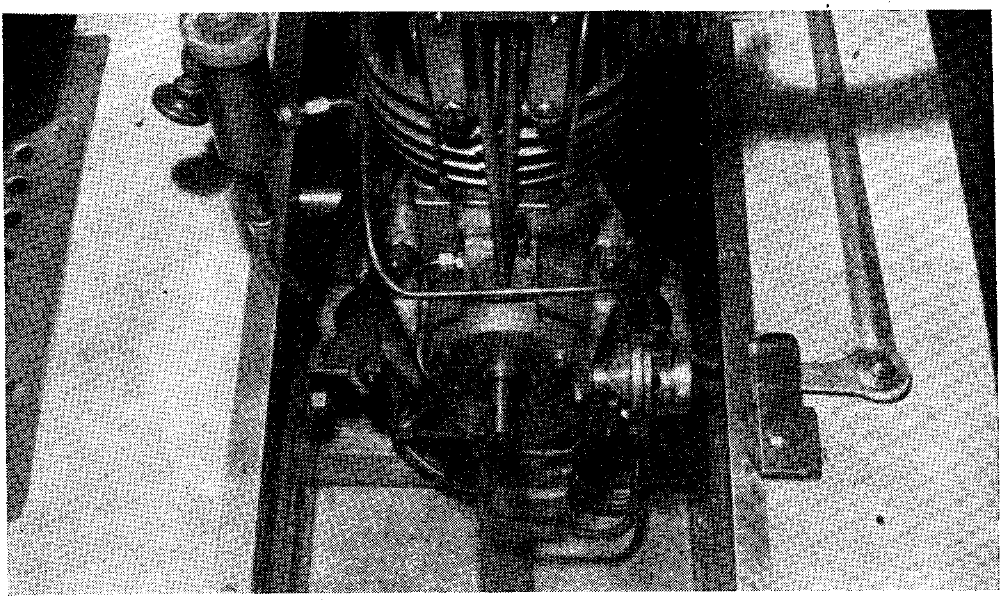


Fig. 2. Showing petrol pump, oil pump and feed pipes to valve stems

and are fitted with split collars. Valves were turned from Rudge exhaust valves.

The cylinder-head was cast in aluminium, the port passages being drilled and then reamed with radius-ended reamers and rough-finished

The valve seats were p.b. inserts shrunk in and the aluminium surrounding same peined over as a double security, the interior of the head being finished off after this operation.

The piston was of aluminium alloy (an old

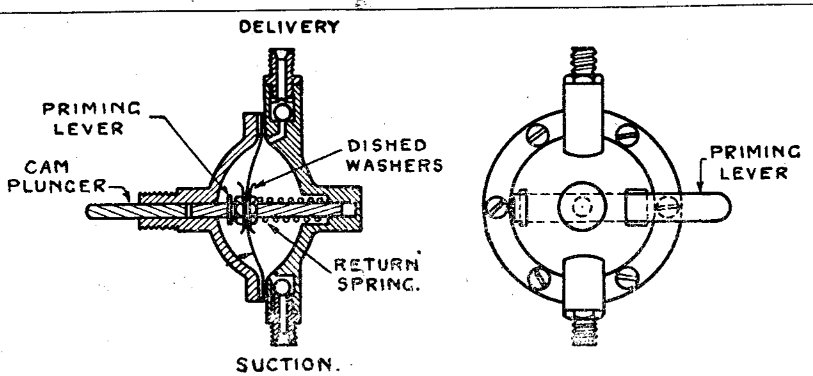


Fig. 3. Details of petrol pump

with rotary radius cutters driven by a flexible shaft from a small electric motor.

The necessary smooth finish was obtained by mounting a piece of thick rubber tube on to a spindle driven by the flexible shaft.

This piece of rubber tube was allowed to

motor-cycle piston melted down) and was cast in a mild-steel die-casting mould. The core was of the three-piece type for purposes of extraction.

All internal parts of the mould were given a high polish and thoroughly coated with graphite before use.

The best results were obtained by heating the mould to a blue-black heat, pouring in the molten aluminium slowly to about $\frac{1}{4}$ in. under the top of the header tube, dropping in a piece of mild-steel that just fitted the latter, and quickly giving it a good whack with a hammer.

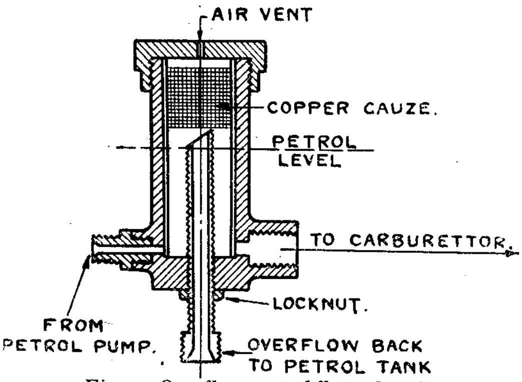


Fig. 4. Overflow type of float chamber

This had the effect of forcing the molten metal into every corner of the mould.

Plenty of taper must be given to all parts of these moulds, as otherwise extraction is very difficult. If, at the first attempt, a faulty casting is produced, in most cases it is due to not getting the mould hot enough.

Of course, all dross must be skimmed from the top of the molten aluminium before pouring and a sprinkle of Borax well stirred in will help to bring all impurities to the top.

The cylinder consisted of a finned c.i. liner with the aluminium fins shrunk on.

The fins on the liner coincided with the fins on the aluminium, thus giving a better surface contact.

The crankcase was cast in aluminium and comes well up the cylinder base, thus giving additional support to same.

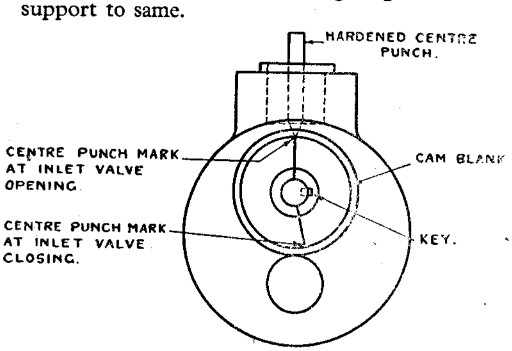


Fig. 5. Method of marking opening and closing points on cam blanks

All ball-race housings were fitted with shrunk-in p.b. liners. These liners resisted the hammering effect transmitted to the ball-race, which would soon become loose in the housing if not so fitted.

The double gear-wheel oil-pump worm driven at 1/40 c.s. speed was fitted with a cam on its upper end. This engaged with a horizontal plunger which, in turn, works the petrol pump, as shown in Fig. 3. The stroke of the petrol pump was controlled by the length of this plunger, and, in this case, the stroke was 0.060 in. This pump was fitted with a double diaphragm and has proved very reliable. One thing to watch in constructing these pumps is to arrange that the delivery passage from same is at the extreme top and slopes upwards. This will avoid any possibility of trapped air.

Petrol was delivered to a simple overflow type of float chamber, as shown in Fig. 4. Petrol level was easily adjusted by screwing the overflow pipe up or down. When first fitted, a considerable amount of petrol agitation was noticed above the top of the overflow pipe and was eventually cured by fitting a roll of copper gauze, as shown.

Cams

These were originally made of case-hardened nickel chrome, but gave trouble through splitting at the keyway.

The best material was found to be Ubas mild-steel carburised and hardened.

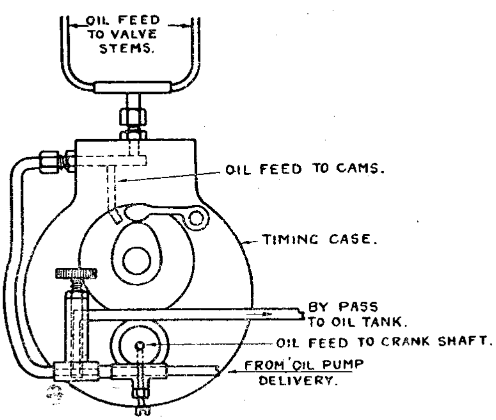


Fig. 6. Oiling arrangement

Before carburising, the bore was sealed off by a $\frac{1}{8}$-in. bolt passed right through with washers and nuts each end.

Carburising in a mild-steel pot for two hours gave excellent results.

The method of making these cams was as follows :—

Having decided on the valve lift necessary, the point of opening and shutting and the lift at every 5 deg. of crankshaft rotation, two master cams four times full size were marked out and filed up accurately.

The cam blanks were then turned up, bored and reamed a press-fit on the camshaft and the keyways cut.

The camshaft complete with gear-wheel having been previously prepared was pushed on to the cams. The key must be a tight push-fit.

This was then fitted into the timing case, the cover put on and bolted up tight.

A piece of hardened silver-steel with a point at one end was then dropped through the tappet

hole with the point resting on the cam blank, as shown in Fig. 5.

Two 180 deg. celluloid protractors fastened together to make a complete circle of 360 deg. were secured to the crankshaft.

With the piston at t.d.c., a pointer was attached to the crankcase and made to register 0 deg. on the protractor.

The crankshaft was then turned to 30 deg. b.t.d.c. and the pointed piece of silver-steel resting on the cam blank was given a sharp tap with a hammer. This was repeated for the closing point 64 deg. a.b.d.c. The exhaust cam was treated in a like manner at points 60 deg. b.b.d.c. and 27 deg. a.t.d.c.

Similar marks had already been made on the master cams.

The latter were then clamped down on a copying machine (which I was lucky enough to have access to at the time) together with the cam to be cut, making sure the opening and closing points were in the right positions.

Running the milling cutter round the cam was the work of a few minutes and produced a very nice finish.

This method could, of course, be used where cams have to be cut in the lathe.

As proper lubrication is so important in these high-speed engines, the various points requiring consideration were dealt with, as shown in Fig. 6.

The oil was taken first to the roller-bearing big-end, the amount being controlled by the needle-valve as shown, then by drilled oil-ways in the timing case to two small pipes immediately over the cams. Thus oil is squirted direct on to the cams, which I consider a very desirable feature in view of their heavy loading.

Connected to this drilled oil-way were two small-bore pipes supplying oil to the valve stems. These pipes, together with the petrol pump and oil pumps, can be clearly seen in Fig. 2.

Both oil and petrol pumps got their supply from separate tanks in the stern and were connected to them by celluloid tubing.

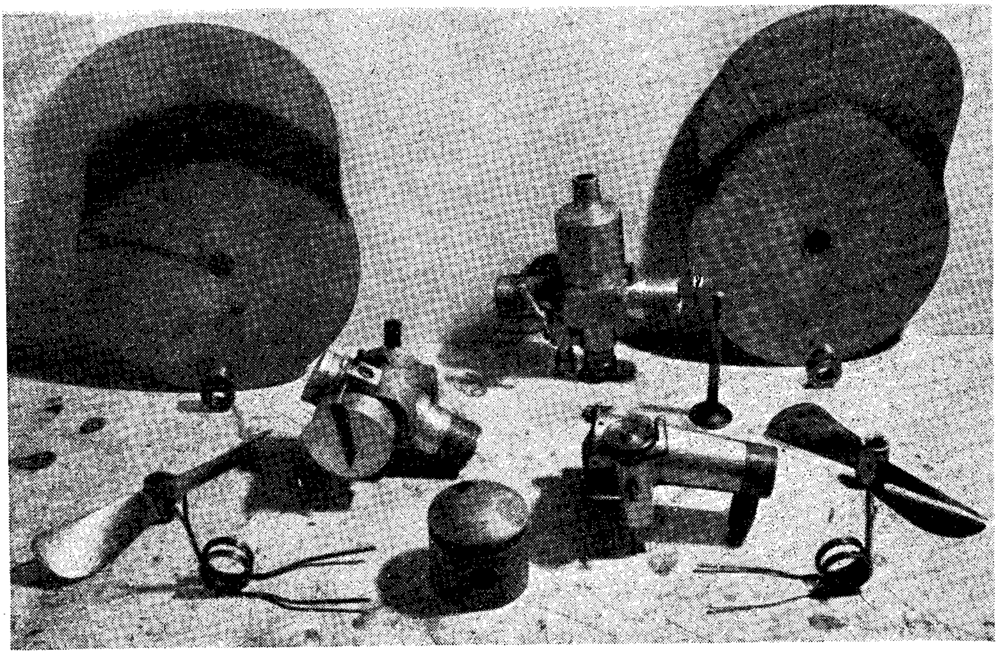


Fig. 7. Master cams, carburettors, propellers, etc.

This tubing was quite reliable and had been fitted to all feed and return pipes. It was flexible, and allowed the flow of oil and petrol to be seen. It was a tight fit on the o.s.d. of $\frac{1}{8}$-in. copper pipe and was just pushed on for about $\frac{1}{2}$ in. and has never leaked or vibrated off. It was, of course, not suitable for dope fuel.

In all, four carburettors had been made, No. 1 being a simple type with adjustable jet situated in a small horizontal venturi giving 0.005 in. clearance round the jet. This small venturi entered the main choke tube at right-angles. Choke tube diameter was 11/32 in. This type, although allowing the engine to produce plenty of revolutions, made it very difficult to get the boat away.

No. 2 was a miniature s.u., but in spite of very accurate workmanship and months of tuning with various needles and air-ways, could not be made to function correctly. Piston flutter was one of the chief difficulties.

No. 3 was of the barrel throttle type with annular diffuser and variable jet by taper needle connected to the throttle by a small slotted lever. This again gave very indifferent results over the mixture range, but I feel that further work on this type would be worth while.

No. 4 was the compensated annular diffuser type and was made to Mr. Westbury's instructions given in THE MODEL ENGINEER. This gave the boat a much better get-away and it was found possible to increase the choke diameter to 13/32 in. This, I know, was against the theoretical diameter of ¼ in., but there you are, the engine weak spark at starting speeds and quite failed to start the engine with a compression ratio of 11 to 1. The present one had a double Alnico magnet armature with pole-pieces attached and coil wound in accordance with Mr. Westbury's instructions in THE MODEL ENGINEER. The weight came out at 1 lb. 11 oz., and, although

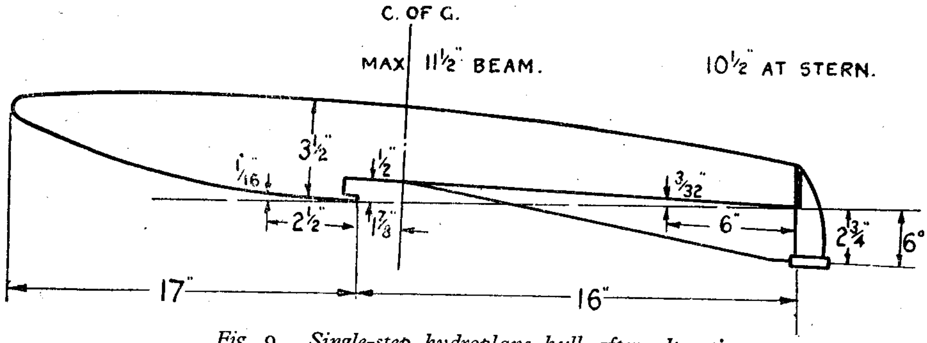


Fig. 9. Single-step hydroplane hull after alteration

revolutions increased acceleration and get-away was in no way affected. Three of these carburettors, together with other bits and pieces, are shown in Fig. 7.

The magneto previously mentioned was the third constructed. The previous ones had single Alnico armatures ground away to give the necessary shape, but through insufficient metal in the armature and faulty coils, produced a very lot heavier than I expected, gave an excellent ⅜-in. spark at very low speed.

It was driven from the propeller shaft by a 2-to-1 reduction gear housed in a suitable aluminium box, as shown in Fig. 8. Also shown is the celluloid cover with domed top covering the coil of the magneto, oil and petrol tanks and delayed action switch. This switch was connected to the contact-breaker and choke by light Bowden cable.

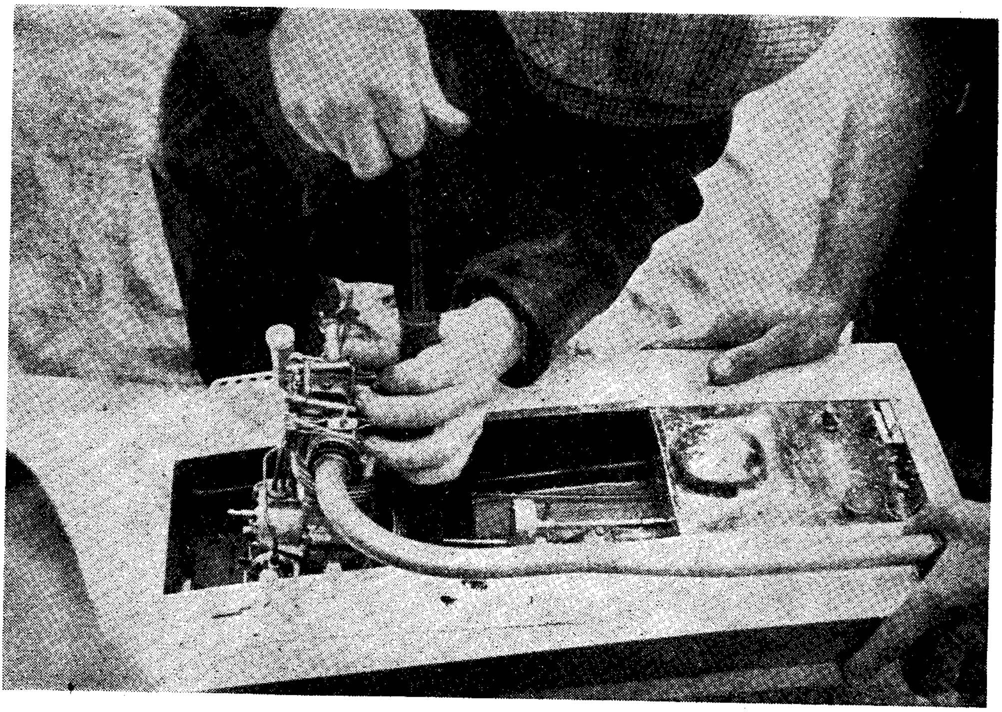


Fig. 8. Showing drive to magneto

The hull shown in Fig. 9 was the next item required, and, as the racing season was just commencing, something had to be done quickly. Fortunately, Mr. Clark, of the V.M.S.C., had one which he kindly let me have. In due course the plant was installed and the boat given a trial run.

With hopes running high and rather a shaky hand, the engine was started and the boat hitched on to the line. As speedboat men will know, there is a certain technique required to get these high-speed boats away. Just the right setting of the choke, just enough advance to the magneto and just enough vigour in the push-off when you let her go.

Well, I must have been sadly out of practice, because a large bow wave arose, nearly swamping the engine. The latter made a gallant effort to keep going, but conked out after a few yards.

The knack, however, was soon acquired, but in spite of alterations to propeller angles and shifting the centre of gravity, the hull proved very unstable over 30 m.p.h. It was then decided to alter the planing angles, and these were reduced, and finished up as shown in Fig. 9.

This completely cured the trouble and the hull was as steady as a rock up to 40 m.p.h.

Several runs of 30 and 35 laps were run off, which proved that if the speed was not sensational, reliability was there.

The boat at this period weighed 12½ lb. As this was considered rather heavy and one of the chief things controlling speed was the power/weight ratio, it was decided to build another hull, endeavouring to reduce weight wherever possible.

About this time the writer became acquainted with what the Americans were doing with surface propellers and the very high speeds obtained with quite small engines.

Various American journals were obtained and the illustrations and information carefully studied.

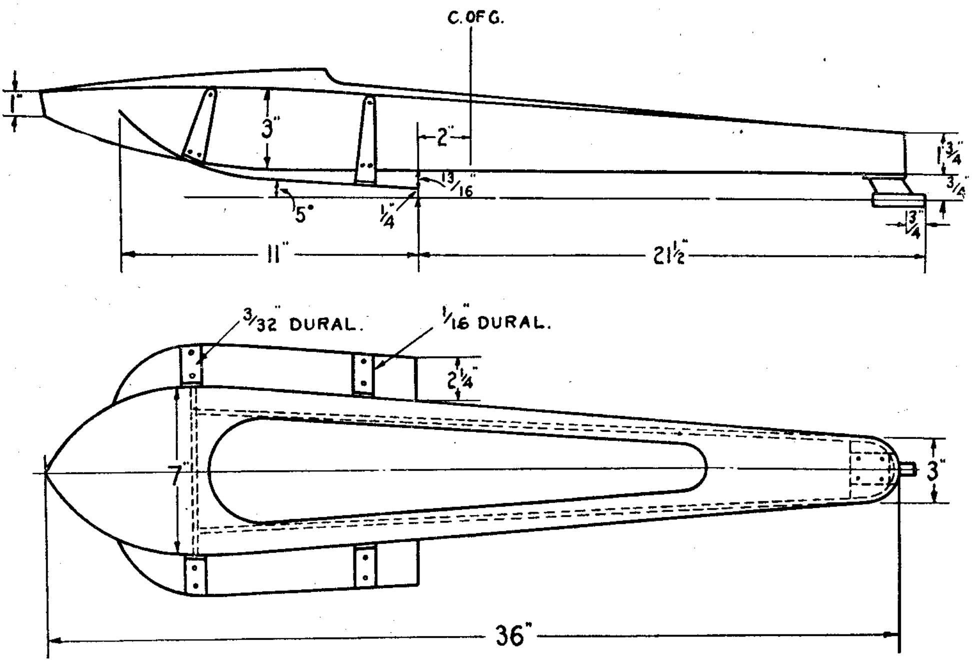


Fig. 10. *Surface-propulsion type hull*

It was realised that these high speeds were obtained by—

(1) High revolutions, using dope fuel.
(2) Light weight.
(3) Reduction of skin friction by making the hull rise right out of the water and plane on two narrow skids or floats.
(4) Reduction of drag caused by the propeller shaft, skeg bracket and bearing, as these were also clear of the water when running.

A hull embodying these features should certainly be faster than the orthodox single-step hydroplane, and the urge to try one out resulted in plans being laid down to build one 36 in. long.

Two pieces of mahogany 26 in. long, $\frac{5}{16}$ in. thick by 3 in. wide were obtained. These formed the longitudinal members, to the front of which a cross-piece was anchored, as shown in Fig. 10.

The rear ends were fastened to the semi-circular stern-piece.

Elongated holes were cut wherever possible for lightness, but the points where the engine bearers were to be fastened were left solid. A solid piece of mahogany formed the nose or bow and ¼-in.

(*Continued on page* 261)

MODIFICATION OF ELECTRIC REPEATER MOTORS

by F. R. Lucas

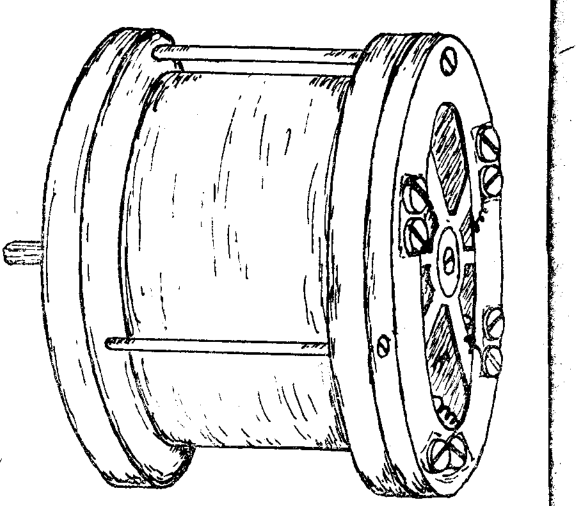


Fig. 2

THESE motors, as supplied, are designed for the remote operation of equipment from a master control or switch. A typical arrangement that can be adopted is shown in Fig. 1. With this arrangement the motor will step around in either direction under direct control of the master switch.

A suitable application would be the remote control of a wireless receiver.

Construction

The motor consists of a laminated two-pole rotor built up of soft-iron laminations pressed on a shaft, mounted in ball-races. This is free to revolve in a field consisting of six field coils, each one connected in series with its opposite coil, thus making three sets. One connection from each of the three sets is taken to common negative (−) and the other connection from each set to terminals marked 1, 2 and 3 on the motor end-plate (Fig. 1).

Modification

By means of a simple modification to the field connections and the rotor, the repeater motor may be converted to work as an extremely useful a.c. synchronous motor 12 V to 20 V, with many applications for the workshop enthusiast and modelmaker.

Field Windings

Two of the six field windings are utilised, and any *opposite pair* may be selected. The two windings chosen are connected in parallel, the existing terminals on the motor being used. Connections from the power supply of appropriate voltage are then taken to these terminals. The spare windings are simply left disconnected and ignored.

The Rotor

The two-pole laminated rotor or armature core (Fig. 3), must next be modified to form a four-pole rotor, with pole-pieces of somewhat reduced width (Fig. 4).

The modification is carried out in the following manner :—

Remove motor end-plate and rotor. Next, file away 5/32 in. metal along the length of the rotor on each tip of the laminations. Care should be taken to ensure that equal amounts of metal are removed in order that the rotor remains perfectly balanced, otherwise uneven running may result.

The rotor is now held in a vice, and by means of a suitable clamp or spanner, one-half of the laminations are rotated through 90 deg., thus producing a rotor with four poles (Fig. 4).

It will be found that if the rotor is warmed

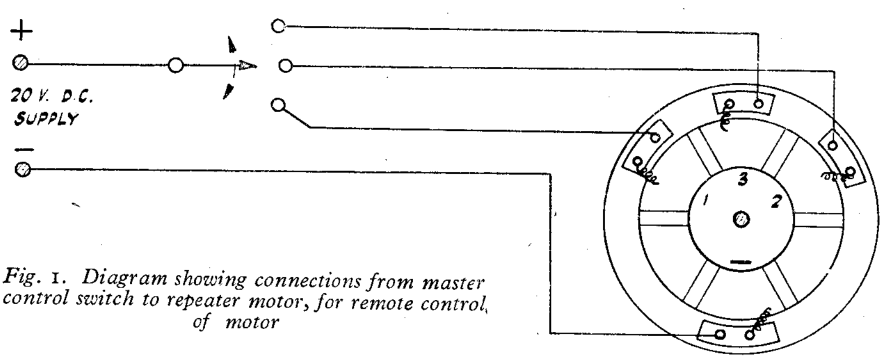


Fig. 1. *Diagram showing connections from master control switch to repeater motor, for remote control of motor*

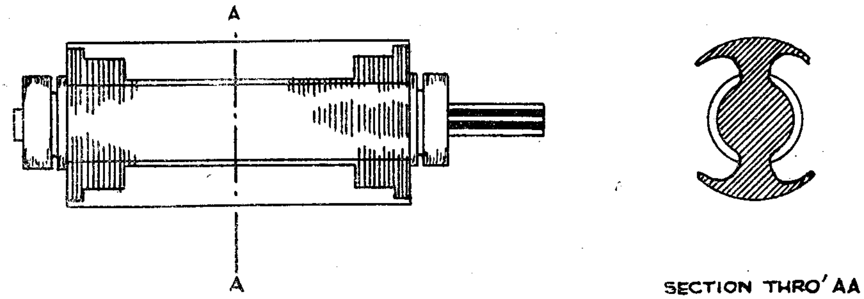


Fig. 3. *Armature core, before modification*

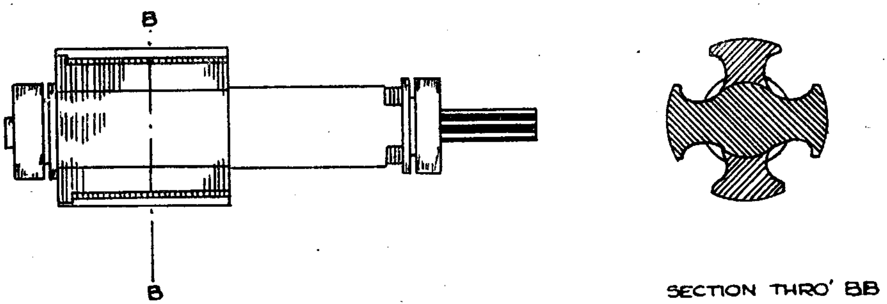


Fig. 4. *After modification*

somewhat—*not* made red-hot—100 deg. C. will do—the laminations will twist more easily.

Finally, reassemble motor, making sure that the rotor turns freely, and connect to supply.

It should be noted that this type of motor is not self-starting and will require spinning to start. Its speed will depend upon the frequency of the supply.

In Quest of Speed

(*Continued from page* 259)

square ash the frame on which the $\frac{1}{16}$-in. 3-ply sides and bottom were screwed.

The engine was next installed, but instead of the magneto being at the stern and driven through a gearbox, it was brought forward in front of the engine and driven off the camshaft through a universal joint.

This saved quite a bit of weight.

The delay-action switch, with all its controls, was discarded, as it was learnt that the method of starting this type of boat was to have the engine revving flat out and hurl the boat forward when starting.

This worked quite well after a little practice. Several alterations had to be made to the angle of the front skids, as the boat was leaping right out of the water. These were finally set at approximately 5 deg., as shown in Fig. 10.

Another point where the writer came "unstuck" was in thinking that, because only one blade of the propeller was in the water at a time, it should therefore be twice the diameter. This proved to be far from the case, and the propeller has had to be reduced in diameter until it is now only $\frac{1}{4}$ in. larger than the totally-submerged type. This point is rather significant and seems to point to the fact that there is a lot more cavitation in the totally-submerged type than was at first thought.

Now as regards speeds with this type of hull. Although no records have been broken, there is every indication that with a little more tuning, something in the region of 50 m.p.h. is quite possible.

Have I got another hull in mind? Yes, and this time it will be constructed of dural tube with aluminium sides and bottom. It will be powered by a 30-c.c. two-stroke, and lightness will be the keynote of design.

But sufficient unto the day thereof.

The 4-in. DRUMMOND LATHE

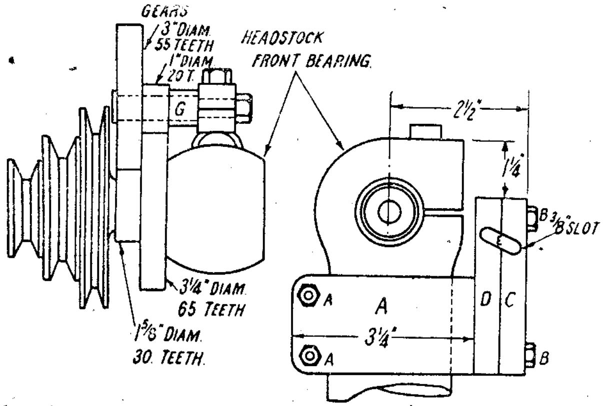
Alterations and Additions

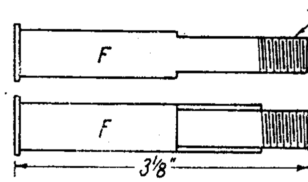
by H. E. Birkett

AFTER the completion of the treadle stand, described in THE MODEL ENGINEER for May 20th, work was started on "Olympiade." When the turning of the wheels was started, the need of a backgear to give a speed low enough to turn cast-iron became apparent. As the cutting of gear-wheels was a lengthy process and also because I had no experience or knowledge of gear-cutting, I decided to buy a set of gears. A hunt round the tool shops in Birmingham produced the vee-pulley fitted to the lathe, and a set of gears which would give a backgear reduction in speed of 6 to 1. This means that, with the electric motor driving the lathe, the lowest speed is approx. 30 r.p.m. One gear of 30 teeth is fitted to the three-speed vee-pulley. There is a double gear with 35 teeth and 20 teeth and one large gear of 65 teeth on the mandrel. A new mandrel had to be made for two reasons. One :—the end-thrust on the lathe was originally taken by a fibre washer between the cone pulley and the rear headstock bearing. This would not be possible when the cone pulley has to turn on the mandrel with the backgear in operation. Reason two :—it was considered that the ¾-in. Whit. mandrel nose would be better replaced by a 1 in. × 12 threads with a 1⅛-in. register so that an interchange of chucks, faceplates, etc., could be made with a friend who has a Myford "M" lathe.

So a new mandrel was turned before the new pulley was fitted, and the fibre washer to take the thrust was placed behind the thrust collar of the mandrel where it bears against the front headstock bearing. This was to be a temporary measure until a ball thrust-race could be built into the headstock, but it is still running quite well after some months' use.

After the new mandrel was completed, except for the screwcutting of the mandrel nose and the facing of the collar and register, a steel bracket (shown in sketch *A*) was made from ⅛-in. × 2-in. black M.S. strip. Two pieces of ¾-in. × ½-in. B.M.S. were cut 3 in. long and one of these was riveted, and later brazed, to the steel bracket. The bracket was, of course, shaped to fit around the front headstock bearing filler and was locked in position by ⅜-in. bolts *A.A.* Clearance holes for ⅜-in. bolts *B.B.* were drilled in piece *C* and piece *D* was tapped to suit. Then the slot *E* was drilled and filed to shape to allow sufficient movement for the back gear to be engaged or withdrawn.





The stud for double gear

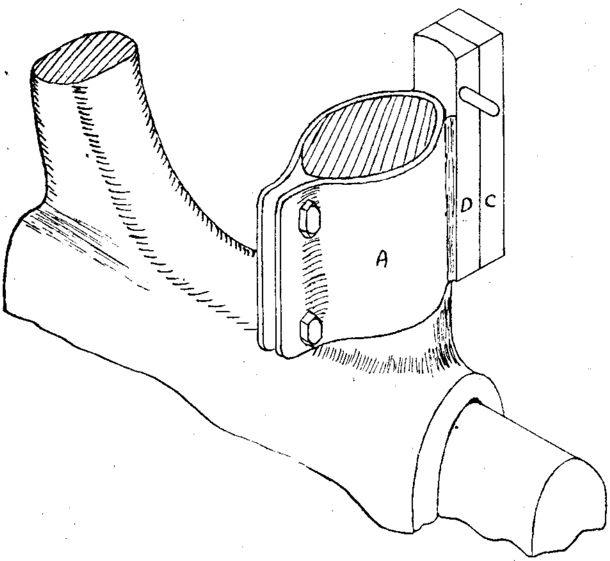
Left—Steel bracket. Position of headstock

A spindle *F* (in drawings) was turned, to hold the double gear, and it is locked by a ⅜-in. Whitworth nut. *G* is a tubular washer to hold the double gear in place in line with the pulley and mandrel gear, and to allow the double gear and spindle to be dismantled when necessary.

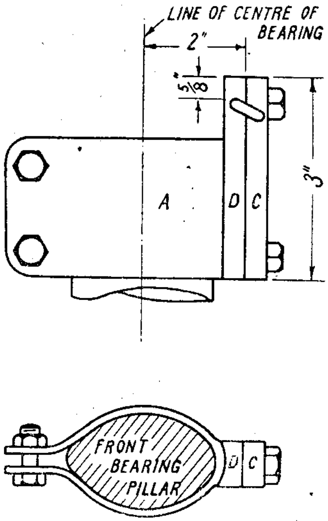
Operation of the backgear involves the removal and replacing of the cone pulley locating and locking grub-screw. The screw is removed when the backgear is used and replaced when the direct cone pulley drive to the mandrel is needed. This is not so much of a disadvantage as it seems and can be done quickly and easily. When the backgear is needed, the grub-screw is taken out and the double gears are moved into mesh, up the slot in the bracket, and then locked in place by the nut on the end of the spindle. The large gear wheel is keyed to the mandrel and locked with a small grub-screw. The mandrel nose register and screw thread were cut after the mandrel was fitted.

Locking Handles for Cross-slide and Tailstock

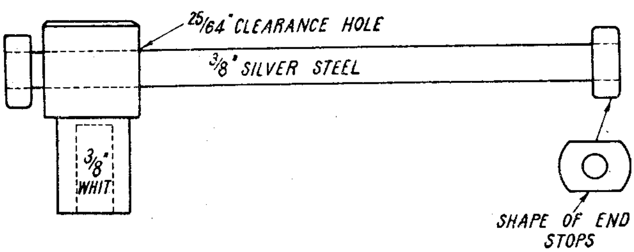
These alterations were carried out as a result of experience in using the lathe, because it was found that much time was wasted when a spanner was needed to lock the tailstock, saddle and cross-slide. So locking handles were fitted in



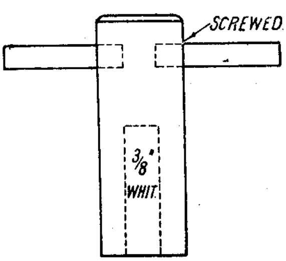
Sketch of steel bracket in position on front bearing pillar



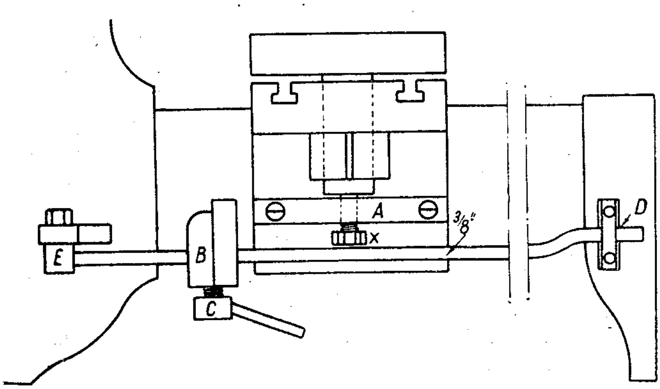
Details of steel bracket



Locking handles for tailstock and front cross-slide



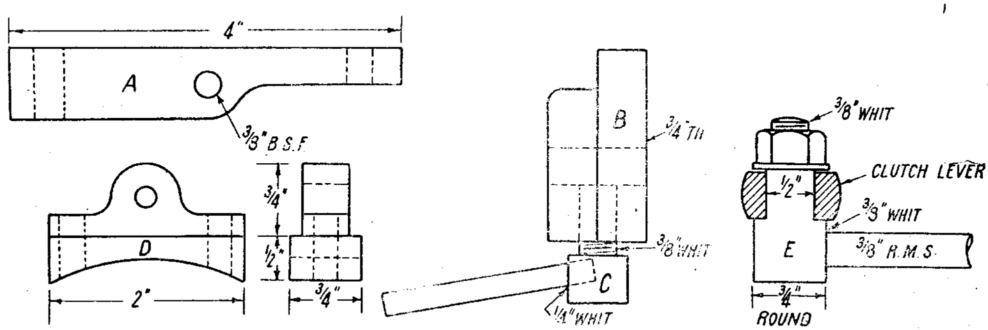
Rear cross-slide locking handle



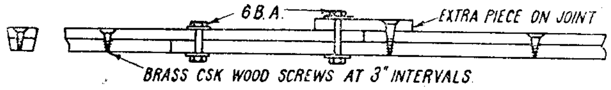
General arrangement of saddle-operated throw-out for leadscrew clutch

place of the $\frac{3}{8}$-in. nuts on the cross-slide locking and tailstock locking (see sketch). The two locking handles have loose levers sliding in a clearance hole to allow the handles to be turned, owing to the positions of the locking devices on the tailstock and cross-slide locking. The rear cross-slide locking, actually on the saddle, enables the saddle to be easily and quickly locked in place when facing or milling.

A locking handle of the usual familiar pattern on lathes was fitted to the tool-post.



Details of parts A, B, C, D and E



Improvised vee belt

Saddle-operated Throw-out for Leadscrew Clutch

Another addition was the fitting of an automatic, saddle-operated throw-out for the screw-cutting dog clutch. It was fitted because the lathe was, for a time, in use in a school handicraft room, as I had no workshop. To avoid the danger of a boy allowing the saddle to run into the chuck when the saddle was operated by the leadscrew, the throw-out was devised from available material, $\frac{3}{4}$-in. and $\frac{1}{2}$-in. and $\frac{3}{8}$-in. round bright mild-steel. The parts are shown in the sketch. Part *A* is screwed to the saddle by two cheese-head $\frac{5}{16}$-in. screws while the long bar along the side of the lathe bed is $\frac{3}{8}$-in. round B.M.S. The bracket *D* is of two pieces of $\frac{3}{4}$ in. $\times$ $\frac{1}{2}$ in. brazed together as is the body of part *B*. *E* was turned from $\frac{7}{8}$-in. B.M.S. and is, in effect, a shouldered bolt. Part *A* is tapped for a knurled or serrated-headed $\frac{3}{8}$-in. B.S.F. bolt which bears against the bottom of the cross-slide pillar to give adjustment for height to the cross-slide and cutting-tool point.

An Improvised Vee Belt

A vee belt, needed at short notice, was improvised from a length of 1-in. flat leather belting. The belt was first cut into two strips each $\frac{1}{2}$ in. wide which were screwed together at intervals of 3 in. with flat-head brass joiners woodscrews. This provides a belt roughly $\frac{1}{2}$ in. sq. in section, the ends of which were stepped as in the drawing and joined, after the length had been found, by two small 6-B.A. bolts and nuts. The belt was then nipped in a vice and the sides carefully skived down to the proper angle for a vee belt. During three months on a drive for a lathe on a moderate speed, the belt has given satisfaction.

A Novel Idea in Soldering Practice

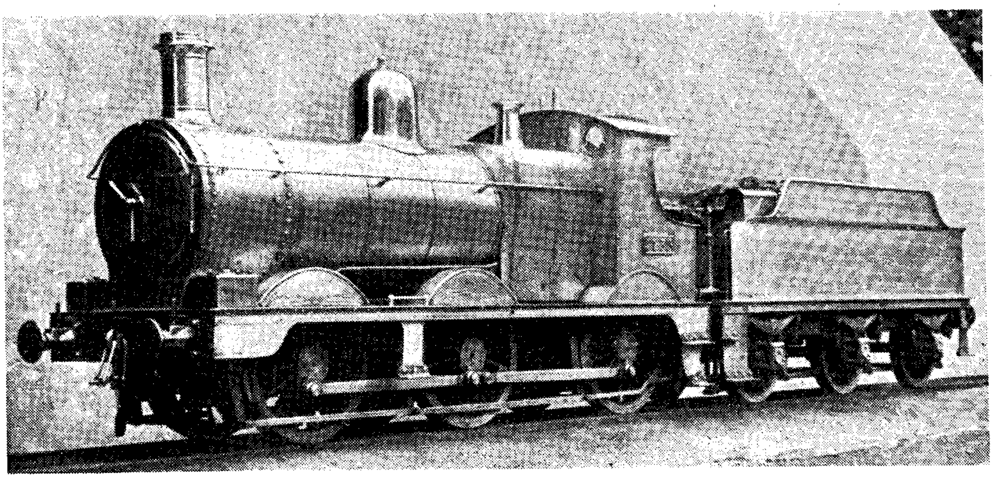
ONE of the problems of a soldering-iron in use is the tendency for solder to accumulate on the iron. This may incur loss of time and wastage in repetitive work, and has given large-scale users of soldering much food for thought.

But the problem has been solved in an ingenious way by a large electrical undertaking. All soldering-irons are cleaned, as routine, and when warm, dipped into a vessel containing one part of "Aquadag," a concentrated dispersion of colloidal graphite, in about four parts of water.

When the warm iron is withdrawn from the liquid it will be found to carry a thin adherent film of graphite. No soaking of the iron is required, but merely a dipping into the liquid, the residual heat in the iron drying the graphite film almost instantaneously after withdrawal. The iron should not be so hot as to cause violent hissing or boiling of the water.

The tip of the iron is then cleaned, to remove the graphite film, and soldering carried out in the normal way. It will be found that solder no longer adheres, as before, to the face of the iron away from the tip. The underlying idea of this little practical tip is not new. Colloidal graphite has been used for many years as a mould dressing in die-casting, the graphite film formed by the product giving excellent parting.

Soldering-irons can be treated in batches at the commencement of the day's work, the amount of colloidal graphite used being very small. The frequency with which irons need be re-treated depends on the amount of soldering carried out, but the graphite film, if formed properly, has a long life.—E.A.S.



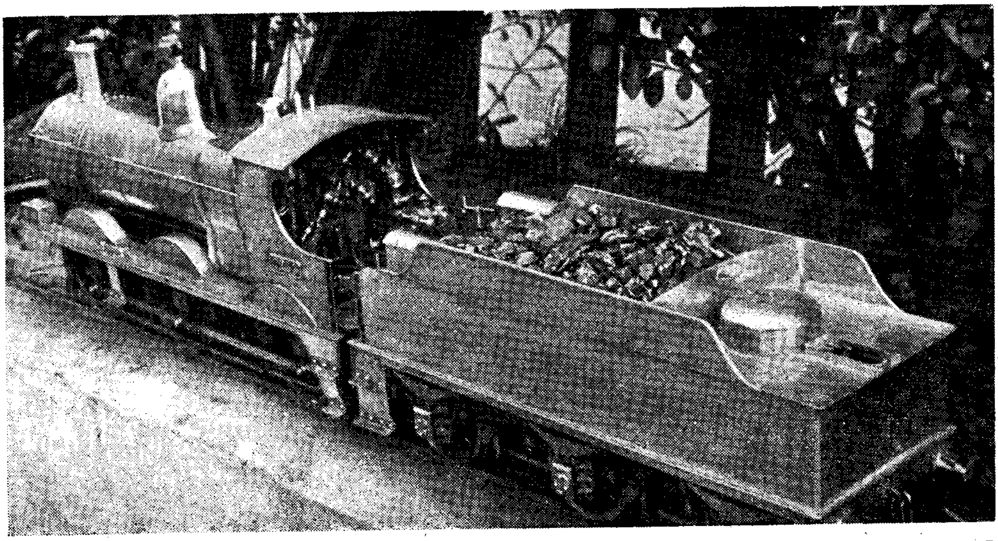
"MOLLY DEAN"

by H. C. Robinson

THE heading looks as though the printers had misprinted the title of a well-known song; but, in this age of jet-propelled, streamlined monstrosities, I thought, perhaps, the photographs reproduced herewith would act as a kind of "balm" to the feelings of all true lovers of the good old-fashioned steam locomotive.

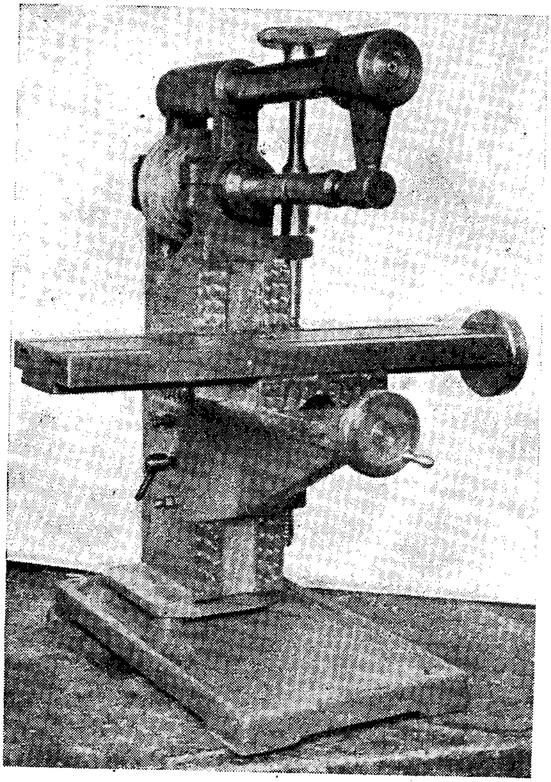
My model is to ¾-in. scale and has taken about eighteen months to build. And I might add that it is a locomotive that was "worth modelling" in that everything below the footplate is "Molly" with slight variations to the axle centres, while the driving and coupled wheels are larger and of correct G.W.R. pattern. With the Swindon boiler and mountings, it makes up into what I consider to be a pretty good copy of a famous old "warrior." The word "warrior" is, I think, very appropriate, as it is a well-known fact that many of these engines did yeoman service abroad in World Wars I and II.

Owing to the fact that I cannot claim any originality in the design of this locomotive, I do not feel justified in describing the building of her. I think all praise is due to two very clever engineers, "L.B.S.C." and the late Mr. William Dean. And, with all deference to the former gentleman, I propose to name her "Molly Dean." She is fitted with a sight-feed lubricator, as described by Mr. F. Cottam, which can be seen in the cab-view photograph.



A NEW LIGHT MILLING MACHINE

THE usefulness of a small milling machine in the model engineering workshop is beyond question, and although on many occasions there have been debates as to whether it is of greater or less practical utility than a small shaper, it is fairly safe to say that the reaction of the average model engineer would be " how happy I would be with either ! " In the past, both types of machine have been produced in a simplified form, adaptable to amateur requirements, but of late years, many of these machines have evolved into much more elaborate and expensive productions to suit the professional engineer, with the result that both in respect of size and price range, there has been practically nothing available within the reach of the average amateur.



The Garner horizontal milling machine

It is, however, gratifying to note that steps are now being taken to remedy these deficiencies, and that both shapers and milling machines specially designed for the amateur have made a welcome appearance within recent months. Messrs. T. Garner & Sons Ltd., of Barnsley, who introduced a very useful hand shaper at last year's " M.E." Exhibition, have now followed this up with an equally useful and interesting bench milling machine, a sample of which has been submitted to our inspection and test.

The Garner horizontal milling machine must be one of the smallest ever produced, apart from the machines designed specially for horological work, and it is as simple in its design as is compatible with practical requirements, but it is nevertheless robust and sturdy, and has a capacity for work comparable with that of much larger machines. Its height is approximately 16 in., length in the plane of spindle axis 12 in., and width over table 13 in. (overall dimensions in all cases). The height of the spindle axis from the bedplate is 12 in., and the overarm support gives a clearance of 2 in. over the spindle centre, so that cutters up to a maximum of 4 in. diameter can be used with the overarm in position. A sturdy spindle, bored to take a No. 2 Morse taper arbor, is fitted, running in phosphor - bronze half-split bearings, and provided with a three-step cone pulley for $\frac{3}{8}$ in. vee belt, with pulley diameters of $1\frac{5}{8}$ in., $2\frac{3}{8}$ in., and $3\frac{1}{8}$ in. respectively.

The column and headstock of the machine are made in a single integral casting, and are mounted on a cast bedplate of large area to give stability. The table is 11 in. in length by $3\frac{1}{2}$ in. wide, with two longitudinal tee slots, and it has a cross movement of $2\frac{1}{4}$ in., with a vertical movement of 6 in. A unique feature of the vertical traverse is that the operating handle is located in an accessible position at the top of the machine instead of the more usual position below the table, which is often found inconvenient, and sometimes calls for special arrangement of the machine mounting. All slides are hand scraped and fitted with adjusting gibs, and a locking clamp is provided on the vertical slide. The knee which supports the table is of robust design and strutted beneath to ensure rigidity.

The equipment available for the machine includes a special countershaft unit for bench mounting, incorporating a platform for a $\frac{1}{4}$ h.p. motor, an arbor to take cutters with $\frac{1}{2}$ in. centre hole, and a specially designed machine vice. Prices for the machine and its equipment are lower than that of any milling machine which has been brought to our notice since the war.

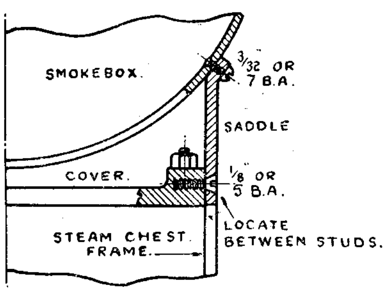
From our experience with this machine up to date, we are very much impressed with its capabilities, and regard it as one of the most important contributions to amateur machine shop equipment which has been made in recent years. Apart from its usefulness in its initial form, it embodies the sound form of basic design which we have always commended as a nucleus for the further improvement and elaboration by the user. For instance, it would be a simple matter to equip the machine with a dividing head, a small rotary table attachment, indices on all slide screws, and adjustable table stops.

"Maid of Kent" and "Minx"

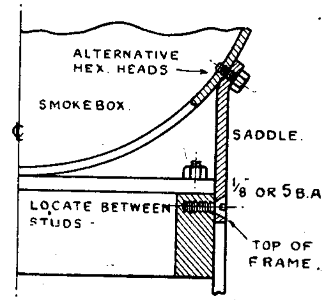
by "L.B.S.C."

How to Erect Boilers

WHEN all the boiler fittings have been attached, the next job is to erect the boilers, and connect up the pipes. The first item is to fit the smokebox to the boiler; and as this merely means putting a smear of plumbers' jointing on the inside of the bevelled ring at the back of the smokebox, and pressing same on to the end of the boiler barrel for ¼ in., it is soon done. Be careful to have the vertical centre-line of the chimney in line with the ditto of dome and safety-valves; if the chimney lops over to one side, and the dome to the other, folk may wonder whether it is due to Bass or Guinness!



A "second thought"



Saddle attachment for "Minx"

Next job is to fit the smokebox saddles; and here, I find that if my nearly-worn-out noddle had only worked a little quicker, I could have made this job easier. Those builders who haven't yet made their cylinders, please take heed. I should have specified a steam-chest cover with a rib along each side; then all you would have had to do, would have been to put three or four screws through clearing holes in the sides of the saddle, into tapped holes in the ribs. If your steam-chest cover isn't permanently fixed yet, silver-solder a rib on each side; merely a piece of flat brass rod. You can't use angle, as the nuts on the studs would foul. The stud holes are drilled clean through the rib, and the nuts go on top, as shown in the illustration. The screws holding the saddle, go between the studs.

The insides of the cast saddles are filed so that the saddle will fit over the little bit of steam-chest standing above the frames. In the case of the "Minx," there is enough projecting, to allow a screw to be run through each side of the saddle, at the front end, just above the frames, into a tapped hole in the side of the steam-chest; and two more can be put in at the front. Use ⅛-in. countersunk steel screws, and don't make the holes in the steam-chests deep enough to risk piercing the walls. As the steam-chest of the "Maid" only projects above the frames by the thickness of the cover, this fixing cannot be adopted, as there is not enough metal to afford a secure hold for the screws. To avoid disturbing the steam-chest cover, if you have it nicely screwed down, a piece of angle, projecting forward beyond the saddle, could be silver-soldered to each front corner of same. Either brass or steel angle would do; if the regular material isn't available, bend up a bit of ⅛-in. sheet or strip brass. Put the saddle in position, then drill a couple of No. 30 holes clean through frame and angle each side, and secure with ⅛-in. or 5-B.A. bolts; or if preferred, drill frame No. 30, drill angles No. 40, tap ⅛ in. or 5-B.A., and use set-screws in lieu of bolts. No fixing is required at the back end of the saddle; when the smokebox is in position, it is impossible for the back to lift.

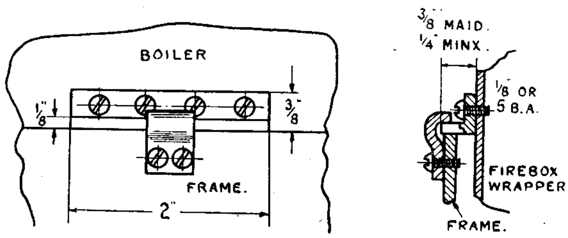
The boiler can now be placed on the frames. It will automatically locate itself, as the blast-pipe must of necessity come under the centre of the chimney, and the height is governed by the saddle. Set it so that the barrel is parallel to the top of frames; suitable bits of rod laid across the frames will hold it at correct height whilst you mark off the location of the expansion-brackets, which are pieces of ⅛-in. brass angle, ⅜ in. by ⅜ in. section for the "Maid," and ⅜ in. by ¼ in. for the "Minx," as her firebox is wider. If the correct section isn't available, use the next size larger, and file to size; but I shouldn't be surprised if our advertisers produce the odd-size one as a casting. Anyway, four No. 30 holes are drilled in the angle as shown, and it is placed on the frame between the coupled wheels, and resting against the boiler. Run the drill through, make countersinks on the boiler, follow with No. 40, and tap 5-B.A. Use brass screws to attach the angles, and sweat over the whole lot, like stayheads. The angle never has to come off any more, and the sweating is insurance against leakage. To prevent the boiler lifting, each angle may be held down by a clip, made from 3/32-in. brass, copper, or steel, attached to

the frames by two ⅛-in. or 5-B.A. screws running through clearing holes in the clip, into tapped holes in the frames (see illustration).

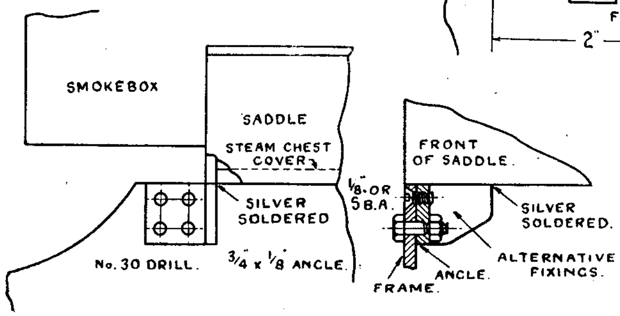
The smokebox is held down to the saddle each side, by a row of 3/32-in. steel screws put through clearing holes in the flange, into tapped holes in the smokebox shell. Those good folk who love to see bolt heads sticking out all over a locomotive, can let themselves go here, and use hexagon-head screws. The cup-head rivet lovers can use round-heads, and the screws will look like rivets when the paint has filled up the slots in the heads. Please yourselves! The main steam-pipe union in the smokebox is then connected up, and the blower-pipe put on. To line up the blast-nozzle with the chimney, I always use a piece of round steel (silver-steel is best, as it is usually straight and true) which fits nicely in the hole in the nozzle. This is placed in the nozzle, and the pipe adjusted until the end of the rod standing up at the top of the chimney, like a sweep's rod minus the brush, is exactly in the middle.

The interstices at the bottom of the smokebox, where the pipes come through, are then sealed. If the smokebox isn't airtight, the engine won't steam. About the best stuff I have used, is asbestos string well treated with plumbers' jointing, and prodded in with a bit of stiff wire flattened at the end. Another good material is composed of scraps of asbestos millboard kneaded up to a sort of putty, with a little water; this sets fairly hard. A very good way, and one which I adopted on both "Jeanie Deans" and "Grosvenor," is to pack the saddle full of asbestos flock or wool, before fixing the smokebox down on it; this not only stops up all air leaks, but keeps the top of the steam-chest warm and cosy, like the layer of firebricks on the cylinders at the bottom of many full-sized smokeboxes.

When you have finished working inside the smokebox, put a smear of plumbers' jointing all around the edge, and press the front in. I usually set the ring in position, so that the door hinges are horizontal, when checked with a scribing block; then the ring is gradually tapped home by applying the end of a stick of hard wood to it, and hitting the other end with a light hammer, starting at the hinge and working right around until the flange of the ring is right home. No further fixing is needed.



Expansion bracket for boiler



Left—Saddle attachment for "Maid of Kent"

Pipe Connections

The reproduced diagram shows the pipe connections for both "Maid" and "Minx." As with a radio set, or piece of electrical apparatus, where the exact path of the wires doesn't matter within reason, as long as they start and finish at the right place, so it is with our pipes; but it behoves all locomotive builders who take a pride in their work, to make a neat and tidy job of the "plumbing." This is sadly neglected in many cases. I have seen kinked pipes and atrociously-made bends on expensive commercial jobs; and on a professionally-made job which I repaired for a friend, the pipe leading from the drag-beam to the feed-pump had two right angles and three very sharp bends in it!

Another point to watch, is arranging the connections between engine and tender, so that they can be coupled or disconnected with the absolute minimum of trouble. I have, as all followers of these notes know, a "standard" arrangement for both 2½-in. and 3½-in. gauges, whereby any normal engine can be used with any tender, the only exception being in a case like "Jeanie Deans," where the unusual position of the reverse shaft under the drag-beam, precluded the usual connections being fitted. A similar arrangement for 5-in. gauge is given here. One of the worst examples of inaccessibility I have experienced, was the "Royal Spot of Bother" mentioned recently. The connections were right forward under the beam, one of them being close to the footstep, and needing a special spanner to get at the nut; it took a month of Sundays to couple up engine and tender.

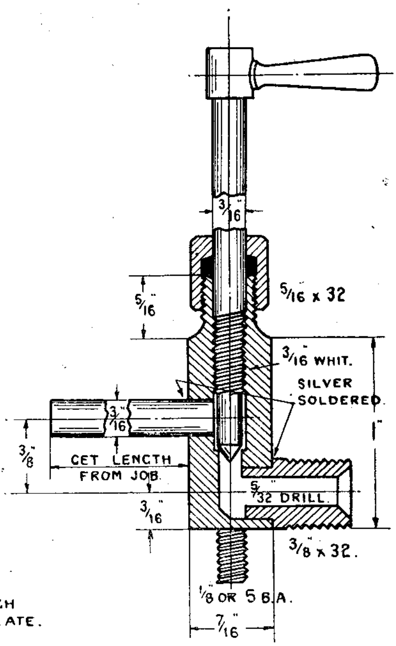
The diagram practically explains itself. The union on the feed-pump is connected to the right-hand-side clack by a short piece of $\frac{3}{16}$-in. thin-walled pipe, with appropriate union nuts and cones on each end. If the pipe is heated to red, full length, when the cones are being silver-soldered on, then quenched out in the acid pickle and rinsed in cold water—let the water run through, to remove all scaling—it will come up

bright after a few rubs with a bit of steel wool, and will be soft enough to bend with fingers alone. You won't kink it by finger pressure!

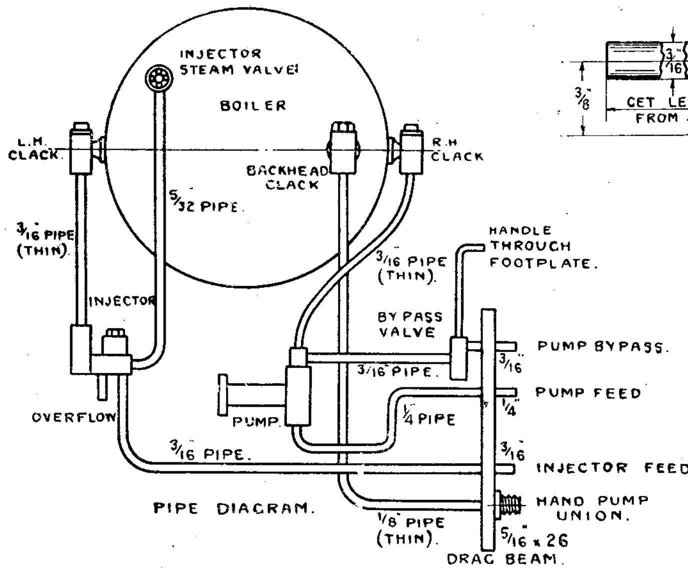
The left-side clack takes the feed from the injector, which is located by the left-hand foot-step and is easily removable for cleaning. The delivery-pipe from this, doesn't go between frames at all, but will lie underneath the running-board, close to the valance, when these are put on. This gives the water a clear unobstructed run from the injector clack to the boiler clack. Details of the injector will follow in the very near future. The pipe from the hand-pump union is connected to the clack on the backhead; and the pipe from the pump to the by-pass valve, is run along near the frame, and set so as to be clear of the ashpan.

By-pass Valve

The by-pass valve itself is a simple screw-down gadget; and as its internal anatomy is precisely the same as the other screw-down valves already described, and made in the same way, there is no need to repeat the full ritual. The body is made from $\frac{7}{16}$-in. round rod (bronze or gunmetal for preference) drilled $\frac{1}{8}$ in. to within $\frac{1}{16}$ in. of the end, then opened out and tapped to take a $\frac{3}{16}$-in. valve pin. I recommend using Whitworth pitch for this valve pin, as the coarse thread gives quicker action. The upper end of the valve body is screwed for a $\frac{5}{16}$-in. by 32 gland nut as shown, and the valve pin is left long enough to project up into the cab. You can set the height of this to your own liking; I prefer them high enough to be easily reached, and on "Grosvenor" I have made the by-pass handle represent the handle of the hand-brake on the engine, which big sister had when she first came out, before she was equipped with the Westinghouse air brake. At $\frac{3}{16}$ in. from the bottom of the valve, a union screw, $\frac{3}{8}$ in. by 32 is fitted; and $\frac{3}{8}$ in. above that, on the opposite side of the valve, a piece of $\frac{3}{16}$-in. pipe is silver-soldered in, to take the hose connection to the tender. The length of this is best obtained from the actual job. If the frame is brazed into the slot in the drag-beam, the valve can be located right close to the beam, and only a short pipe will be needed, to stand out about $\frac{1}{2}$ in. from the level of the beam; but if angles and screws have been used, the valve will be set clear of the angle, so a longer pipe will be needed. This is where your skill as erector and fitter comes in; I'm relying on the good judgment and common sense of builders of these engines, to save making a multitudinous collection of small detail drawings (there are quite enough already!) so don't go and let me down!



By-pass valve



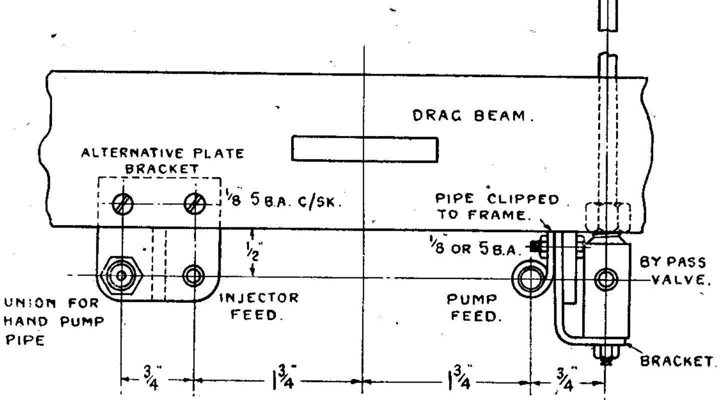
Left—Piping diagram for "Maid of Kent" and "Minx"

The valve is supported by a simple L-bracket attached to the frame by a 5-B.A. bolt, and the other end of the bolt can support the clip holding the pump feed-pipe. Both brackets and clips are made from 16-gauge steel. Connect bottom union of valve with by-pass union on pump, by a $\frac{3}{16}$-in. pipe with appropriate union nuts and cones on each end.

The union screw for the tender hand-pump connection, and the feed pipe for the injector,

can be attached to the opposite side frame by two clips placed back to back and secured by a single bolt; or alternatively, they can pass through two holes in a flat piece of 16-gauge steel, attached to the inside of the drag-beam by a couple of screws, if the frames have been brazed up. If angled, make the bracket from a piece of angle also, and screw it to the underside of the beam. The clips, however, make the neatest job. Tip—solder the tail end of the union screw into the clip, to prevent it turning, when coupling or uncoupling the nut on the tender pipe. It saves a lot of time, trouble, and railroad Esperanto!

The feed-pipe from the drag beam to the union at the bottom of the valve box on the pump, is made from ¼-in. copper tube, for two reasons. The most important one is, that the water must



Tender connections at drag beam

have a free flow to the pump, if same is to work with full efficiency; and the water only has gravity plus the atmospheric pressure (due to the "suction" of the pump ram) to make it travel from the tender tank to the pump valve-box. It is, of course, a different tale on the delivery side, when the ram is doing the forcing, and a smaller pipe will carry the water under pressure, from the pump to the boiler. But here again, the flow should not be restricted, and if 3/16-in. pipes are used (I specify this size for the sake of neatness, although even this size is much bigger than "scale") they should not be thicker in the wall than 24-gauge. If thin pipe is not obtainable, it would be advisable to use a larger size, 7/32 in. or even ¼ in. On a test made on one of the Stroudley engines, it was found that when running at 60 m.p.h. there was a pressure of 900 lb. per sq. in. in the pump delivery-pipes; one reason why old Billy adopted six-inch valves on the tank engines' pumps and three suction and three delivery valves per pump, on the "Gladstones." Eccentric-driven pumps on little engines were at one time dismissed as "unsatisfactory," but that was only due to errors in design. Incidentally, a correspondent recently wrote me that a pump he had made to my specification had failed after a couple of runs, and was absolutely useless. I told him to emulate the famous old Lancashire mill engineer, and give the valve-box a crack with a hammer. He did—and the pump immediately started! Deposit from impure feedwater had stuck the inlet valve on its seating; nothing else was amiss. It frequently happens.

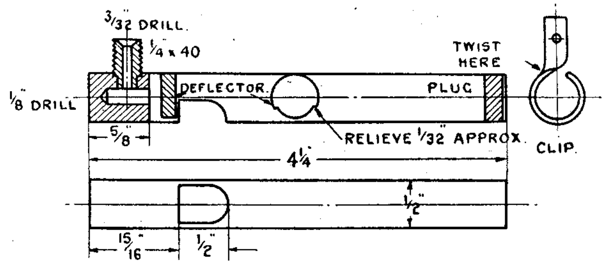
Whistle

The whistles for "Maid" and "Minx" are the same; I will describe one of a new kind for "Doris," that sounds more "L.M.S.-ish." The former's whistles are made from ½-in. brass tube, about 26-gauge. Square off the ends in the lathe, to a length of 4¼ in. Plug one end, and file the arch-shaped hole as shown, at the opposite end. This should not be filed to half the tube diameter, but a little less, otherwise the whistle may develop a screech. To deflect steam across the hole, a brass disc ⅛ in. thick is required, one side of which must be relieved, to allow steam to pass between it and the whistle tube. Chuck a piece of ½-in. brass rod in the three-jaw, and turn down about ¼ in. of it to a drive fit in the whistle tube. Now, with a parting-tool over ⅛ in. wide, or a square-nosed tool in the slide-rest, relieve part of the circumference by feeding in the tool and pulling the lathe belt by hand, rocking the mandrel back and forth, until the tool has cut away 1/32 in. of metal, to a length equal to the straight end of what I call the "noise hole." Part off at ⅛ in. from the end, then press the disc into the tube, so that steam issuing from the groove between disc and tube, will blow right across the hole. The approximate position is for the disc to be level with the straight end of the hole.

Chuck the rod again and turn down a little over ⅝ in. to a press-fit in the tube; centre, drill down about ⅜ in. depth with ⅛-in. drill, and part off at ⅝ in. from the end. Before pressing this home it would be advisable to test the whistle by air pressure; and this can be done by putting a cork or piece of round wood in the end, with a bit of pipe stuck through it, and connect same to a motor tyre pump. Squeeze or bend the flexible pump connection so that no air can pass, then press the pump handle down as hard as you can; when you can't push it any farther, release the connector, and let the blast of air go through the whistle. If you don't get a clear note, the deflector disc needs adjustment one way or the other. When O.K. put a spot of Baker's fluid or other liquid flux, and a bead of solder, in the tube, against the disc, opposite to the groove, and hold the lot over a gas or spirit flame. The solder will melt and seal the disc in position. Only a weeny

bit of solder is needed, otherwise the groove will get blocked up and you won't get any toot at all.

Press the end-piece in; then, at about $\frac{7}{16}$ in. from the end, and opposite to the sound hole, drill a $\frac{3}{16}$-in. hole through tube and plug, into the central hole. In this, fit a $\frac{1}{4}$-in. by 40 union screw. The spigot should be a good squeeze fit in the hole, and can be soldered as well if desired; ordinary soft solder will do. The whole arrangement is shown in the illustration. Finally, make a couple of little clips from 18-gauge sheet brass or copper, $\frac{1}{4}$ in. wide; bend around to clip the whistle tube tightly, then twist as shown. The whistle can be hung across the frame, just below the bottom edge, anywhere you like between the drag-beam and the firebox; the clips are attached to the frame by 3/32-in. screws, or bolts, whichever you prefer.



Whistle

The union on the whistle is connected to the one on the turret nearest the handle, by a $\frac{1}{8}$-in. pipe, thin-walled for preference, as shown in the view of the backhead fittings. All we need now will be grate and ashpan, and the injector; then we are ready to see what the "Maid" is made of (did I hear somebody murmur "Kent"?) and whether the "Minx" really is!

PRACTICAL LETTERS

Leadscrew Indices

DEAR SIR,—In Mr. R. F. Slade's recent article on an index dial for a 12 t.p.i. leadscrew, he states that one thread of the screw moves the slide 0.0833 in. and multiplying this by three gives 0.2499 in., which is near enough 250 divisions.

This suggests that there would be some cumulative error, but later in the article Mr. Slade states: "On trying the dial mounted up on the feedscrew, it was found that no error was apparent."

Now, there are 3,000 "thirds of a thou." in 12 revolutions of the dial (or 1 in. travel of the slide). Therefore $\frac{3,000}{12} = 250$ divisions exactly, there being no error as Mr. Slade might lead one to think.

Yours faithfully,

Coventry. A. R. WEBB.

Refrigerators

DEAR SIR,—It appears that quite a number of domestic refrigerators have been made by your readers, and I, being one of the home manufacturers, have been hoping that someone would entertain us with an account of any snags which might crop up and how to eliminate them.

My 'frig follows the usual lines, but instead of the usual elaborate evaporator, has simply a zig-zag grid of $\frac{7}{16}$-in. copper pipe (tinned) secured to the top of the compartment. This compartment is made of aluminium sheeting and has 3 in. of cork insulation between it and the outer casing which is also of aluminium; hard wood has been used for the framework, to which the interior is screwed. The doors are also about 3 in. thick with a rubber tube seal at the outer edge.

The compressor works satisfactorily and frost forms on the coil within 20 minutes of starting up, and the temperature falls to 30 deg. F. in 45 min. or so, but it gains heat, in my opinion, rapidly, and the temperature rises to 40 deg. F. in about 20 min., when the thermostat cuts in again. This means that the motor runs an average of 8 hours out of 12, which to me appears to be a lot, or is it not?

The only thing that occurs to me is that I have used some 3 in. × 1 in. soft wood battens to support the interior chamber and also strengthen the outer case, and that heat transference may take place along these pieces of soft wood.

The other item which has baffled me so far is a slight leak of the gas (methyl chloride) which loses most of the gas within 9 months, and I would be grateful for any suggestion which might enable me to trace it.

Also, can a reader give me any information as to the correct pressures in the liquid container and the evaporator coil?

Yours faithfully,

Richmond. ERNEST V. FIRTH.

Steam Ploughing Engines

DEAR SIR,—The photographs on page 622 (December 9th issue) are Fowler plough engines as Mr. Stebbings suggests (page 58, January 13th issue), but have been reboilered by Oxford Steam Plough Co., Cowley, now John Allen & Sons, Oxford. The Oxford Steam Plough Company made about eighteen sets of plough engines, which included compounds and single-cylinder slide- and piston-valve engines. This firm still own a great many steam rollers; all the plough engine sets except one were sold up not long ago, but one engine is to be preserved by the firm.

Yours faithfully,

Sandford-on-Thames. R.J.C.